Online Information is Not Sex Education:

Evidence from a Wikipedia Access Experiment in Malawi*

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Abstract

Health misinformation can cause individuals to misjudge risks and lead to dangerous disease outbreaks. Expanding internet access has been shown to increase health knowledge along many dimensions. Yet, we show that in the context of the HIV/AIDS epidemic, simply providing access to a high-quality online source does not effectively counteract pervasive health misinformation. We study a randomized trial providing Wikipedia access in Malawian secondary schools. Despite intensive use, and soft nudges to search for correct information, nearly all students retain critical misconceptions related to pregnancy and HIV risk. Misconceptions persist and prevail for years after students gain access to the full internet. We also find limited impacts on long-run sexual behavior and attitudes. High confidence in incorrect beliefs, and distraction by other online content, may help explain the results. In this setting, access to a high-quality online source does not substitute for effective sex education, and direct information provision may be necessary.

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1 Introduction

The spread of health misinformation poses a serious threat to individuals and society. Misinformation arises across contexts and with varied motivations, from deliberate campaigns to minimize the dangers of smoking, to flawed vaccine research and fear-based HIV myths (Krishna and Thompson, 2021). False beliefs can deter people from taking precautions, increase health risks, and lead to disease outbreaks (Bursztyn et al., 2023). The internet mediates misinformation by providing users with access to a range of content, both true and false. Users can find accurate and up-to-date information on almost any topic, including health. On the other hand, the internet is rife with misinformation (Lazer et al., 2018; Carrieri et al., 2019; Acemoglu et al., 2024; Amaral-Garcia et al., 2024; Ershov and Morales, 2024), which can spread with alarming speed (Do Nascimento et al., 2022).

Health misinformation is particularly prevalent, and consequential, in the context of the HIV/AIDS epidemic in sub-Saharan Africa (SSA). Reliable sexual risk information is valuable for girls and young women in SSA, who must protect themselves from HIV and unwanted pregnancy (Anderson, 2018; Karim and Baxter, 2019). Accurate knowledge supports informed choices, and correcting misconceptions about the risks of sex can impact both beliefs and behavior (Derksen et al., 2022; Kerwin, 2025), including for teenagers (Dupas, 2011a; Angrist et al., 2019). Yet, many adolescents in the region do not have access to comprehensive sex education. Sex education is a subject of debate in the region (Achen et al., 2024), and school curricula lack detail (Duflo et al., 2015; Sani et al., 2016). Rather than providing accurate information about risk, educators at times use fear-based messages that highlight the negative consequences of sexuality, which can breed misconceptions (Achen et al., 2024). Moreover, many miss out on the sex education that is provided in schools, as 55 percent of adolescents in SSA do not enroll in secondary school (UNESCO, 2025).

In this paper, we ask whether simply providing prolonged access to a high-quality online information source can effectively combat critical and common misconceptions about sexual risk. While internet use is rising among young people, most in SSA do not yet have access (International Telecommunication Union, 2025). We study the impact of an intervention that provided Malawian secondary school students with access to Wikipedia, an online encyclopedia, during one school year. The intervention provided broad, undirected access to Wikipedia with general encouragement to use it; it was not framed as sexual-health education, and did not steer students toward health-related content. We follow students over five to seven years, to study how beliefs change before and after they graduate and gain access to the broader internet, and whether students search for correct information when nudged to do so.

At the outset, there was reason to believe that if adolescents obtained regular access

to a reliable online source, they might find the information needed to combat health misinformation. The internet is a main source of health information for adolescents in countries with greater access (Borzekowski and Rickert, 2001; Hansen et al., 2003; Gray et al., 2005). And, previous studies have found that the internet expansion has increased knowledge about HIV (Abbasi and Pongou, 2023) and contraception (Toffolutti et al., 2020) across African countries. Moreover, using data from Zimbabwe, Agüero and Bharadwaj (2014) argue that those who complete secondary education know more about HIV not because of sex education, but because they are more likely to seek accurate information through newspapers, television and other media. And, in Uganda, those with more education show a greater awareness of new HIV risk information (De Walque, 2007). Providing access to online information in schools gives students the opportunity to verify information they have heard from parents and teachers, and contradict prevailing misconceptions. Indeed, we hypothesized that students would search for accurate information on the topics that impact them most, including academic subjects (Derksen et al., 2022) and sexual health. HIV/AIDS is perhaps the most important threat facing young Malawians. It is the leading cause of death for both men and women.[1] 6 percent of Malawian women become infected before age 25, and HIV prevalence is similarly high among women who complete secondary school (11 percent) and women who do not (10 percent, DHS 2016).[2]

We analyze data from a randomized controlled trial in four Malawian government boarding schools where students had no other internet access. The sample included all 1,508 students in the last three years of secondary school, of which 301 were randomly assigned to the treatment group. Treatment students were invited to browse Wikipedia freely, privately and anonymously, after school and on weekends, on digital devices in a supervised classroom. Treatment students made frequent use of the new resource, with the average student spending 29 hours overall on Wikipedia.

We measure knowledge, using a repeated set of multiple choice questions, at the end of the school year and in a long-run survey several years after respondents had left school and gained access to the broader internet. At the end of the school year, we administered two endline surveys, several weeks apart, nudging all students to search for correct answers in between. For the long-run survey, we attempted to reach all treatment students and a randomized subset of control students, and achieved an 85 percent response rate. At this point, most participants had smartphones and used the internet frequently. This survey served several purposes: to test whether early Wikipedia access changed how students use the internet after graduation, with possible effects on beliefs and behavior; to document whether misconceptions persist after all participants have access to the

[1] Based on data from the World Health Organization: https://data.who.int/countries/454 accessed on 11 July, 2025.

[2] Data from Uganda suggests that attending secondary school does delay sexual debut for girls (Alsan and Cutler, 2013).

full internet; and to collect retrospective data on adolescent sexual behavior, pregnancy, and marriage. As part of the long-run survey, we also provided direct information to all respondents to counteract some misconceptions, capturing knowledge measures both before and afterwards.

For our knowledge measures, we focus on four key facts about pregnancy and HIV risk that are widely misunderstood, yet are critical in determining behavior and outcomes. The facts about HIV risk are not overly complex, even for those without a secondary school education. Indeed, Derksen et al. (2022), Kerwin (2025), and Dupas (2011a) have shown that these misconceptions can be corrected through fairly simple information interventions. And, while Oster (2012) finds a limited impact of some basic facts about HIV on behavior, the HIV misconceptions we focus on have been shown to impact health behaviors in randomized experiments.

First, we ask about the timing of the fertile window, about which only 16 percent of Malawian women have accurate knowledge (DHS, 2016). This timing is important for family planning where contraception is not always easily accessed. Second, we ask about the risk of HIV infection from unprotected sex with an infected partner. Kerwin (2025) finds that a majority of Malawian respondents believe the per-act infection risk to be 100 percent; the true risk is less than one percent (Wawer et al., 2005). Kerwin (2025) finds that this belief leads to riskier behavior, as those who believe HIV infection is inevitable ("fatalism") abandon caution. Third, we ask about *treatment as prevention*: the potential for HIV treatment to prevent transmission. A person who is treated with antiretroviral therapy (ART) is very unlikely to transmit HIV (Cohen et al., 2011; Rodger et al., 2016; Bavinton et al., 2018; Rodger et al., 2019). Yet, in surveys conducted by Derksen et al. (2022) in rural Malawian communities, two-thirds of respondents were unaware that treatment could prevent transmission to any extent. This incorrect belief reduces demand for HIV testing (Derksen et al., 2022), which is critical for accessing treatment and preventing community spread. Finally, we ask about the risks associated with partner choice. In Kenya, Dupas (2011a) surveyed teenage girls to find that only one-third of respondents understand that older men are more likely to be HIV positive than teenage boys. This misconception, which is also common in Malawi, puts girls and women in Malawi at high risk of HIV infection, as they often prefer older men as partners (Baird et al., 2012; DHS, 2016; Beauclair et al., 2018; Reed et al., 2024). HIV prevalence among Malawian men rises sharply after age 25, putting younger women at risk (DHS 2016, Appendix Figure A1). Providing teenage girls with accurate risk information has been shown to affect partner choice and reduce pregnancy rates in both Kenya and Botswana (Dupas, 2011a; Angrist et al., 2019).

We find that Wikipedia access does not impact critical misconceptions about HIV and pregnancy risk, which are prevalent and persist over years. For each question at each survey point, most students in both treatment and control answer incorrectly. Despite

repeating the same questions over multiple surveys, and providing everyone with a printed copy of the questions, students do not appear to be nudged into searching for answers. HIV-related misconceptions are particularly common. At the end of the school year, fewer than 5 percent of students answer any particular HIV question correctly.

This improves only slightly after five to seven years (at most 15 percent), despite the fact that both treatment and control students now have access to the full internet. Most respondents believe fear-based messages about HIV: that unprotected sex leads to certain HIV transmission, even if a person is on treatment, and that every potential partner is equally high-risk. The impact of the intervention is estimated to be close to zero and is statistically insignificant for all health knowledge measures.[3] We finally observe a shift in beliefs after providing correct information directly to all participants during the long-run survey. We informed all respondents about ART, treatment as prevention, citing the United Nations (UN) as the source of information, which prompted the majority of respondents to report correct beliefs. We then provided correct information about the HIV transmission rate, citing a social media user. This information also increased correct responses, though less substantially than the UN source.

Beyond knowledge measures, we find limited impacts on long-run sexual health behavior, attitudes towards gender and sexuality, and internet use. We do not find any significant effect on unprotected sex in the past month or HIV testing. We find no change in attitudes towards lesbian, gay, bisexual and transgender (LGBT) people or gender equality, with the exception of a positive and significant impact on attitudes towards transgender people among female respondents. This estimate is not significant when adjusting for multiple hypothesis testing. In the long run, respondents in both the treatment and control groups are avid users of the internet, social media, and Wikipedia, with limited differences between the groups.

The stubborn persistence of misinformation despite Wikipedia access, soft nudges to search, and several years of internet exposure is surprising for several reasons. First, our results diverge from findings by Abbasi and Pongou (2023) and Toffolutti et al. (2020), who show that the internet increases basic knowledge about HIV and contraception across African countries. Second, HIV is particularly prevalent in Malawi, and demand for information about sex, among students, is high. Students were able to search for sensitive information anonymously, and spent 7 percent of browsing time on pages related to sex and sexuality. Indeed, the page for "Sexual Intercourse" was the most popular page overall. Third, if students wanted to find sexual health information on Wikipedia it would not be difficult for them to do so. The information needed to answer all of our knowledge questions appears on the relevant Wikipedia pages. The students did use

[3]The study was designed with statistical power to detect a 6 percentage point increase in knowledge, and upper bounds based on 95 percent confidence intervals suggest that the intervention did not lead to a meaningful increase in knowledge among treated students.

Wikipedia intensively, and clearly gained knowledge from Wikipedia, including on topics that were important for their academic success. Derksen et al. (2022) find an improvement in both English and Biology exam scores among low achievers, and use a range of tests to show that students can easily find information they need on Wikipedia.[4]

We conduct further descriptive analyses to highlight two possible explanations for the null results. First, misconceptions are strongly-held: most students who answer incorrectly are certain that they are correct, and may therefore not bother to search for information. Second, Wikipedia offers an abundance of information, and sexual health topics do not capture students' attention to the same extent as topics related to sexuality, or other general interest topics. Topic modeling indicates that the sex-related pages browsed by students were more often about sexuality than pregnancy or HIV. Most of the pages preferred by students were not of the highest quality. Indeed, control group students, who are not distracted by Wikipedia, are slightly more likely to learn about the fertility window (from their teachers and books) than treatment group students. It is possible that some students did search, but the information they found was difficult to understand or contradicted by other sources they trust. However, students report Wikipedia to be highly trustworthy, and use it to find factual information when prompted and incentivized (Derksen et al., 2022). Moreover, students do not appear to be conflicted, nor simply confused by the complexity of HIV transmission. The majority of students, with confidence, report beliefs that are far from the truth and align with common misconceptions. And, after receiving correct information from a trusted source, the majority of respondents appear to quickly shift to the correct answer.

While Wikipedia is a useful resource for students, it does not act as a substitute for effective sex education. Misconceptions persisted even after all students gained access to the full internet, suggesting that broader internet access may not fare better, perhaps due to false and distracting content. Wikipedia does encourage students to read, which has been shown to impact academic performance (Derksen et al., 2022). It may also act as a useful complement to direct education campaigns by allowing users to verify new information. And, while students did not spend much time on pregnancy or HIV topics, they spent more time on sexuality topics, including on topics that are taboo in the Malawian context. This may carry benefits that are difficult to measure, for all students and in particular for LGBT students who may not be able to find relevant information locally.

Our findings contribute to, and present an important caveat to, an existing literature linking the global internet expansion to improved health knowledge, by showing how critical misconceptions remain firmly ingrained over years. Internet access affects a range of outcomes in low-income countries (Hjort and Tian, 2021), and increases knowledge in

[4]Derksen and Souza (2025) also map the social networks within schools, and find that those who gained access to Wikipedia became more well-connected over time.

many domains (Agarwal et al., 2024; Amaral-Garcia et al., 2022; Porcher et al., 2024). In particular, the internet has been shown to increase knowledge of basic facts about contraception (Toffolutti et al., 2020) and HIV (Abbasi and Pongou, 2023) in SSA. Our paper differs from these studies in that we focus on widely-held misconceptions rather than basic and generally-accepted facts: nearly half of Malawian adults do have basic knowledge of the modes of HIV transmission and prevention (DHS, 2016). Children and adolescents may be prone to distraction when using the internet; Malamud et al. (2019) find no impact of home internet access on academic outcomes for Peruvian children. Yet, in previous work we found that Wikipedia access did increase both the ability to find accurate information and important academic knowledge, particularly for low achievers (Derksen et al., 2022). And, we find that misconceptions persist well into young adulthood. The internet can also have negative impacts on adolescent health. For example, a recent study from Italy shows that internet access increases the risk of mental illness among young people (Donati et al., 2025).

This paper also relates to a growing body of research that seeks to understand the causes and consequences of health misinformation, and interventions that counteract misinformation online. Bursztyn et al. (2023) show that health misinformation on television can lead to negative health outcomes, including death, and Carrieri et al. (2019) and Amaral-Garcia et al. (2024) show that online misinformation can decrease vaccination rates. Information campaigns can prevent misconceptions, and influence behavior such as the use of eyeglasses (Ma et al., 2023). Bau et al. (2024) find that low take-up of contraception among Zambian women is in part driven by misinformation and medical mistrust, and that information combined with vouchers increases contraception and prevents pregnancy. Other work by List et al. (2024) and Pennycook et al. (2021) has shown that providing *targeted* interventions that encourage participants to change how they assess information can make them less susceptible to misinformation they encounter online.

Finally, this paper contributes to a broad literature on information interventions to improve health outcomes, by showing that simply providing access to an accurate information source may not suffice. In contrast, simple interventions that provide specific information can effectively correct misconceptions and impact behavior (Dupas, 2011b), including in the context of HIV (Dupas, 2011a; Datta et al., 2015; Dupas et al., 2018; Derksen et al., 2022; Yang et al., 2023; Ciancio et al., 2024; Kerwin, 2025). An "edutainment" approach, which embeds health information into an entertainment format, has also shown promise for improving both HIV knowledge and outcomes for young people (Banerjee et al., 2019). Education campaigns that promote preventative behavior directly, including through typical school-based sex education or clinic-based counseling, have shown limited impacts in the context of HIV (McCoy et al., 2010; Beegle et al., 2015; Duflo et al., 2015; Mwale and Muula, 2017) and in other health contexts (De Buck et al.,

2017). More comprehensive sex education, even delivered through a digital platform, can effectively increase both health knowledge and demand for contraception (Chong et al., 2020).

2 Context and Experimental Design

2.1 Access to Information about Sexual Health in Malawi

Malawi is a low-income country in southern Africa, whose young people face many challenges related to sexual and reproductive health. Nine percent of the population is HIV positive. One third of new infections occur among young people aged 15 to 24, and women in this age group are 5 times more likely to be HIV positive than men (DHS, 2016). As of 2016, 64 percent of Malawian women had had sexual intercourse before the age of 18, and more than half became pregnant for the first time as teenagers. Only 15 percent of teenagers aged 15 to 19 use any form of contraception (DHS, 2016).

The Malawian secondary school curriculum does not include comprehensive sex education, though Life Skills, Social Studies, and Biology classes cover some topics related to sexual health. "Life Skills" in particular was introduced in the 1990s as a response to the HIV/AIDS epidemic (Malata et al., 2023). The curriculum covers relationships and gender equality, culture and religion, self-esteem and personal development, as well as limited information on health and HIV (Malawi Institute of Education, 2013). Importantly, the secondary school curriculum does not include specific information about risk reduction methods such as condoms or other forms of contraception. The curriculum focuses on "resisting pressure to engage in risky behaviors" (Malawi Institute of Education, 2013), suggesting a focus on abstinence and the extensive margin, rather than focusing on the intensive margin. The curriculum also exaggerates HIV infection risk. For example, the junior secondary school textbook contains a cautionary tale about a young woman who contracts HIV the very first time she has sex (Kadyoma et al. 2012, page 61).

School-based sex education excludes many of the most vulnerable young Malawians (Malata et al., 2023). While education attainment has progressed significantly in the past years, as of 2020 only 15.5 percent of Malawians had completed secondary school (UNESCO, 2025), with similar rates for men (15.75) and women (15.25). Based on the basic HIV knowledge measures contained in the DHS (2016), the level of knowledge among young Malawians has remained essentially the same between 2010 and 2016, and most young Malawians have inadequate information on HIV prevention strategies.

Internet access is steadily increasing across SSA, particularly among young people, providing them with greater opportunities to access vital information (see Appendix Figure A2). Malawi remains one of the least connected countries, with 18 percent of the population using the internet as of 2025 (International Telecommunication Union,

2025). 3G and 4G networks are nevertheless widely available, even in rural areas and during electricity outages (Batzilis et al., 2010). While internet infrastructure is present in many parts of the country, Malawian schools do not typically provide internet access to students. Mobile phones are usually prohibited, and computer labs, where available, are typically offline.

2.2 The Intervention

In 2017-18, we implemented an intervention which provided Malawian secondary school students with access to Wikipedia (Derksen et al., 2022). Wikipedia is a reference site providing accurate information on almost every topic. It is an open source site, where content is created, verified, and updated at high frequency through open collaboration. Scientific content on Wikipedia is generally as accurate as, and more up-to-date than, content contained in offline encyclopedias (Giles, 2005). Information on Wikipedia is easy to find using a search function, and articles exist in both English and simple English (as well as in other languages).

Wikipedia is also the most widely-used online health information resource. It includes over 150,000 well-referenced medical articles, which commonly cite top-tier journals and receive consistently high quality ratings (Smith, 2020). Wikipedia contains the information required to correct all of the misconceptions identified above as well as many others. The page devoted to the menstrual cycle contains text and illustrations to explain the fertile window in detail, including its timing and duration. The HIV/AIDS page includes a table with average per-act HIV transmission rates, and states that "an HIV-positive person who has an undetectable viral load as a result of long-term treatment has effectively no risk of transmitting HIV sexually".[5]

The study took place in four government boarding schools. Beyond the Life Skills class, the schools have limited informational resources on sexual and reproductive health, but did have small libraries primarily stocked with assigned text books. Students reside at the school during term and have no access to the internet outside of our intervention. The school grounds have consistent 3G or 4G network coverage. However, students are not allowed to have phones at school.

In each school, we set up a "digital library" in a school classroom, which would be open after school hours and during the weekends throughout the school year. Inside the digital library, students were able to browse Wikipedia using Android devices. The devices were equipped with a software to prevent students from accessing other websites. Students used the digital library under staff supervision, but were free to browse pages privately at their own desks. At most twelve students could use the digital library at a

[5] https://en.wikipedia.org/wiki/Menstrual_cycle and https://en.wikipedia.org/wiki/HIV/AIDS, accessed on 16 October, 2024.

given time. They were not authorized to talk or sit in groups inside the digital library. Students could not leave the library with the devices, but they were allowed to take notes. At the end of the school year, the digital library program was discontinued due to lack of funds.

2.3 Experimental Design

At the start of the school year, students were randomly assigned to either a treatment arm, which gave them access to the digital library, or a control arm. The study included students in the last three years of secondary school (Forms 2, 3 and 4, aged approximately 13 to 18). Randomization was at the individual level and stratified by school, form, whether the student had ever used the internet, and whether the student's baseline exam score was above the median.[6] 301 students were assigned to the treatment arm and 1,207 students were assigned to the control arm.[7] A subset of the control arm was randomly selected to complete additional surveys in both the short and long run. We refer to these 298 students, as well as the 301 treated students as the *survey sample* (599 students in total). Baseline characteristics for the survey sample are balanced (see Panel A of Appendix Table A1), including health-related and gender norms baseline characteristics. We also test for balance on one recall measure captured during the long-run survey: pre-intervention sex before age 18. This measure is significantly lower in the treatment group, a point we return to when discussing the impact of Wikipedia on sex before age 18. This is the only statistically significant difference among the 19 tested, consistent with random imbalance. As designed, the study had statistical power to detect a minimum increase in knowledge rates from 5 percent in the control group to 11 percent in the treatment group, and a 0.22 standard deviation change in HIV risk behavior.

All students attended an information session about the study and Wikipedia, and treated students were invited to a more detailed induction session to learn about the digital library, the use of Wikipedia-enabled devices, and privacy protections. All students were told that Wikipedia could be used to find many types of information, and were given examples related to studying, health, politics, news, sports and celebrities, and were told that they would be free to talk to each other about what they had read online.[8] Treatment students drew a username from a hat, which they would use to log in and browse Wikipedia anonymously. The username allows us to track browsing behavior

[6]The baseline exam score was calculated as the average of the student's English and Biology scores (core subjects for which we have nearly complete data).

[7]At the outset, it was unclear whether the intervention would have a positive impact on students, or would serve primarily as a distraction from their academic studies. We therefore agreed with school administrators that the program should be implemented only for a small share of randomly selected students. The vast majority of students perceived the program as fair. See Derksen et al. (2022) for further details.

[8]Additional details on both the classroom introduction and digital library induction are available in Appendices B and C.

at the level of an individual, anonymous user, and to associate it with some coarsened student characteristics, but not to identify the student behind each username.[9] Students were assured that their searches were anonymous, and that neither researchers, the field team, nor teachers could see what they personally searched for.

Treatment students could browse Wikipedia inside the digital library after school and on weekends. The digital librarians maintained a waitlist, and device use was limited to 30 minutes during high-demand periods. The digital librarian was responsible for ensuring that only treated students could access the digital library by checking the student's identity. This staff member also recorded arrival and departure times for each student, managed the Android devices, and supervised the use of the library.

2.4 A Nudge to Search and Direct Information Provision

After the intervention period, we introduced two additional measures designed to shift participant beliefs and shed light on mechanisms. In the short term, we nudged all participants to search for correct information, and in the longer term, we provided correct information directly. These ex-post measures were designed to support descriptive analysis and mechanism exploration, and were delivered to participants in both the treatment and control groups.

At the end of the school year, we nudged all students to search for three key facts related to HIV and pregnancy risk. The nudge was integrated into a student survey (see Section 4.1). Students were asked three multiple choice questions, about (i) the average length of a woman's fertile window, (ii) the HIV transmission rate, and (iii) whether ART treatment prevents HIV transmission (see Appendix Table A2 for exact wording). Both treatment and control groups were given a piece of paper with three questions and possible answers printed out; the correct answers were not indicated. The students were never directly incentivized to find the correct answer, and were not told that the questions would be repeated later. They were simply told that they could keep a piece of paper with the three questions printed out. We did repeat the same three questions to students approximately two to five weeks later, and again five to seven years later.

Five to seven years after the intervention ended, we also provided all participants with accurate information concerning both HIV transmission risk and HIV treatment as prevention. Information was provided directly in the context of a long-run survey (see Section 4.1). We provided information on treatment as prevention sourced from the United Nations, sharing this statement: *I want to talk about HIV and viral load. Viral load refers to the amount of HIV virus in an infected person's blood. Higher viral load usually means that the infection is worse, and a person with a high viral load may be very*

[9]These include school, form, gender, above median baseline exam scores, and above median number of friends at baseline. To preserve anonymity, usernames were drawn from a separate hat for each group defined by these characteristics.

sick. ARVs can reduce a person's viral load, and if a person takes ARVs properly, the virus can even become undetectable. That means that blood tests will find extremely low levels of virus in the person's blood. According to the United Nations, people with HIV who achieve an undetectable viral load through ARVs – it is impossible for those people to transmit HIV. For the HIV transmission rate question, we shared a statement posted "by an anonymous Twitter user": *the truth is that it's not nearly that easy to get HIV – the medical literature estimates that the transmission rate is actually about 0.1% per sex act.* We chose to share information from the United Nations as well as information posted by a real social media account to support a descriptive comparison of high versus lower-quality sources.[10] Nevertheless, both statements are correct.

3 Sex-Related Browsing on Wikipedia

During the 8-month period between November 2017 and June 2018, we tracked the time students spent in the digital library. Anonymized, individual-level browsing data was collected directly from the Wikipedia-enabled devices throughout the intervention. After students logged in, the devices monitored the Wikipedia pages they looked at and the time they spent on each page.

Every treatment student visited the digital library at least once, and the average student visited 33 times during the school year. Each student spent an average of 29 hours browsing Wikipedia in the digital libraries and looked at 878 distinct Wikipedia pages. Panel A of Figure 1 shows the distribution of time spent browsing Wikipedia; 95 percent of students spent between 2 hours and 97 hours. The distribution is right-skewed for both boys and girls, with boys spending more time on average.

Students spent approximately 7 percent, or 1.5 hours, of their time on pages related to sex and sexuality (Derksen et al., 2022). Our analysis focuses on these pages, using the same classification as in Derksen et al. (2022) to identify pages related to sex and sexuality. Since each page passes through multiple paths in Wikipedia's category tree, we categorize pages as sex-related if 10 percent or more of these paths go through Wikipedia's subcategories for "human reproduction", "human sexuality", "sexual health", and "sexuality and society". Interest in these topics is heterogeneous, with boys spending more time than girls, and 14 percent of students spending more than 4 hours total (see Panel B of Figure 1).

[10] All respondents received the same informational nudge, with each source paired to a specific question. The descriptive evidence therefore cannot disentangle the question from the source. We also reworded the ART question to better match the United Nations statement.

3.1 Topic Modeling and Page Quality

To examine the content of the pages students looked at, we capture the introduction text from each page. The page details are based on the content in Wikipedia as of January 2024, since historical data cannot be consistently collected. In Appendix Tables A3 and A4, we do examine historical (intervention-period) versions of specific pages containing information relevant to the knowledge questions (see Section 3.2).

Restricting our attention to the set of the 3,407 sex-related pages viewed by the students, we classify the content of each page introduction using topic modeling. Topic modeling refers to a broad class of machine learning methods that categorize text-based documents—in this case, Wikipedia introductions—into groups based on how often the terms in those documents occur together. Topic models have been used widely in other social sciences, such as political science (Grimmer and Stewart, 2013; Jelodar et al., 2019), as well as a handful of studies in economics (Gentzkow et al., 2019; Larsen and Thorsrud, 2019; Ferrario and Stantcheva, 2022; Ash et al., 2025). These models are based on the premise that documents are mixtures of topics, and topics are mixtures of words. To determine which words fit within a topic, we compare how often words are used within a particular introduction compared to how often they are used across all introductions (within the set of pages related to sex).

We use a Latent Dirichlet Allocation (LDA) model to identify the main topic in each of the page introductions. LDA is an unsupervised method that identifies words that are more likely to be associated with one another than with other words in the "corpus" of documents (in this case, the corpus refers to the set of all sex-related Wikipedia introductions viewed by students). This model assigns each word in the corpus with a probability that it is associated with each topic (where the total number of topics, K, is fixed). This probability can then be used to predict the primary topic each page belongs to (Jelodar et al., 2019). The assignment to topics is done using the "TextmineR" package in R (Jones et al., 2021), which follows the process:

1. Assign each instance of any word (a *token*), across all introductions, randomly and independently, to exactly one out of K topics.

2. Count how often a given word (e.g. "woman") falls into this topic, across all introductions. This will produce a probability distribution over *words* for each topic and count how often each topic appears within each introduction.

3. Reassign each token, across all introductions, using Gibbs sampling by iteratively doing the following steps:

    - Remove a token from its current topic, to compute the new probability distributions.

- The removed token is then reassigned to a topic where (i) the word is prevalent in the topic and (ii) the topic is prevalent in the introduction the token belongs to. All counts and probability distributions are then recalculated.
- Tokens are continuously reassigned until a stable distribution of topics over words is identified.

The result of this iterative process is to find a set of stable topics, where each topic is characterized by a distribution over words. The number of topics K has been selected based on the optimal level of "coherence," which measures topic quality and reflects how often words in a topic are used together (Jones et al., 2021).[11] We restricted the number of possible topics to between 2 and 25 for interpretability and find that with 14 topics we achieve the highest level of coherence across topics. Since each topic is a distribution over words, several topics can contain the same word if these words appear frequently across multiple topics. In our case, the pages in the corpus have been restricted to those related to sex and sexuality, so the word "sex", for example, appears in multiple topics.

The top terms associated with each of the topics are described in Table 1. To remove human judgment from the labeling process, the topic labels have been assigned using ChatGPT based on the Top 10 words from each topic.[12]

To assess the quality of information that students in the treatment group were exposed to, we supplement the browsing data from the original experiment with information from each Wikipedia page that appears in the browsing data. Using the "WikipediR" package in R, which provides a wrapper of the Wikimedia Application Programming Interface (API) portal (Bar-Hen et al., 2016), we collect information about the content and quality of each page. The quality measures are based on Wikipedia's page content assessment ratings and provide a measure of an article's completeness, which are assigned primarily by Wikipedia editors. Pages of B-Class and above are deemed to be suitably referenced and reasonably well-written. This meets most of Wikipedia's content suggestions, so we assign any page with a category of B-class or higher as being "good" quality (Wikimedia Foundation, 2023).[13]

3.2 Browsing Patterns

First, we examine whether students visited the specific pages on which the answers to the knowledge questions can be found or inferred. In Appendix Tables A3 and A4, we present

[11]The specific measure used here is calculated as the probabilistic coherence, which estimates the difference between (i) the likelihood that a particular word is included in introductions which also include the other words in the topic and (ii) how frequently that word appears across all introductions (Jones, 2019). A higher topic coherence value implies that words associated with that topic are more likely to be used within that topic than in the overall corpus of page introductions.

[12]See chat here: https://chatgpt.com/share/4e6bdf59-9a0b-4da2-b2a0-8b9d26a42723.

[13]For more information on the content assessments, see Wikipedia's Content Assessment ratings.

the list of pages, relevant excerpts, and student browsing statistics. We started with a full list of pages from the topics "HIV/AIDS and Infection", "Human Reproduction", "Pregnancy and Childbirth", and "Women's Reproductive Health". Within these topics, we used a fuzzy keyword search to identify passages in the text of these pages that contain keywords related to the four knowledge questions. This identified a subset of 224 potential pages, which were reviewed by Claude (using Opus 4.8), then verified by the research team to confirm that 17 of these pages included information from which the knowledge-question answers could be found or inferred at the time of the intervention. We use the Internet Archive "Wayback Machine" to find historical (intervention-period) versions of the pages and manually extract excerpts.[14] This process appears to identify the most relevant pages related to each knowledge question, though we cannot guarantee that the answer does not appear elsewhere.[15]

While many students did visit pages with information relevant to the knowledge questions, the average time spent reading these pages is quite small. While approximately two-thirds of students viewed at least one page related to the *Fertility* question, the average time spent is only 4 minutes on this set of pages. The most popular fertility-related page was "Menstruation", which had 3,358 words, and would take 15 minutes to read at 225 words per minute. Yet, the average student spent only 1 minute on the page, or 3 minutes conditional on visiting. For each of the HIV questions, the share of students visiting the relevant pages (1 to 15 percent), and the average time per set of pages (less than 1 minute), are much lower, despite similarly long word counts.

Indeed, sex-related page visits and browsing time are concentrated primarily on lower-quality pages. Figure 2 shows the average time spent on each topic per user (by gender) and the average page quality for pages in different sex-related topics. 15 percent of the 3,407 sex-related pages browsed by students meet the B-class threshold for being of "good" quality, and students looking at these pages spent only 39 percent of their time on good-quality pages. As a point of comparison, Wikipedia pages related to the school syllabus are of higher quality than the sex-related pages browsed by the students.[16] The horizontal line in Appendix Figure A3 shows that 37 percent of all syllabus-related pages meet the good-quality threshold. The subject with the lowest share of good pages is

[14] If multiple versions of the page were available from the intervention period, the historical comparison was based on the earliest version available during the intervention. If no historical versions were available during the intervention window, the last available version from *before* the intervention was used.

[15] The user counts and time measures in these tables aggregate the browsing data over the full intervention period, when libraries were open, from November 2017 to June 2018. Note that since the first endline survey was completed in May 2018, some browsing data was collected after knowledge measures were captured in the short-run survey. These figures should, therefore, be interpreted as an upper bound on students' exposure to pages containing relevant information prior to the short-run survey. As very few students spent time on the relevant pages, this timing does not meaningfully affect our interpretation of findings.

[16] *Syllabus-related* pages are linked to specific topics in the school syllabus, see Derksen et al. (2022) for details.

social sciences, where 26 percent of pages are of good quality. Within syllabus-related browsing, the average student looking at syllabus-related pages spent 58 percent of their time on good-quality pages.

The darker portion of the bars in Figure 2 shows the proportion of time students spend on good-quality pages within each topic. Low-quality browsing is common within topics that are more clearly related to entertainment, such as "sexual activities and behaviors", "pornography and adult magazines", and "genital anatomy and function". Students spent the most time on pages related to "sexual activities and behaviors". The average student spent 44 minutes on this topic, and 19 minutes on good-quality pages within this topic. Topics related to sexual health, such as "women's reproductive health", "pregnancy and childbirth", and "HIV/AIDS and infection" are higher quality both in terms of the proportion of good-quality pages and time spent. For example, 32 percent of pages in the "HIV/AIDS and infection" topic are B-class or better. However, these topics received less attention from students. Students spend an average of 5 minutes on "women's reproductive health", 3 minutes on "pregnancy and childbirth", and 3 minutes on pages related to "HIV/AIDS and infection". As shown in Figure 2, this does not vary substantially across genders. Male and female students spend an average of 6 and 4 minutes, respectively on "women's reproductive health." Males and females spent 3 minutes, on "pregnancy and childbirth," and 3 and 4 minutes, respectively, on "HIV/AIDS and infection."

Overall, male students spent more time than female students browsing sex-related pages. Both male and female students spent the most time on pages related to "sexual activities and behaviors", with male students having spent more time on pages related to "pornography and adult magazines", "genital anatomy and function", and "BDSM and fetish culture". Female students spent slightly more time on pages related to "HIV/AIDS and infection".

3.3 Sexuality Diversity

Beyond information about sexual health, access to online information also provides students with other helpful information they cannot find elsewhere. This may be particularly valuable for students who identify with the LGBT community, as sexuality diversity is a sensitive and/or taboo topic in many cultural contexts. This is particularly true in Malawi, where same-sex relationships are illegal, LGBT visibility is low, and LGBT youth are subject to social isolation (Angotti et al., 2019). Figure 3 shows that students who were more socially isolated spent significantly more time looking at pages related to "gender and sexuality diversity" than students who were less socially isolated. Here, social isolation is defined as having a below-median number of friends (total number of social links) as recorded in the baseline survey.

4 Impact on Knowledge and Behavior

The preceding discussion described how students used Wikipedia to browse information about sex and sexuality-related topics. In this section, we describe the data we use to capture knowledge and behavior outcomes related to pregnancy and HIV, our empirical strategy to estimate the impact of Wikipedia access, and our main results in the short and long run.

4.1 Data

Our outcomes are captured in short-run (endline) and long-run survey data collected from study participants in both treatment and control groups. The survey sample includes 599 students in total, as described in Section 2.3. We conducted two closely-spaced in-person endline surveys at the end of the school year: one in May 2018 and another two to five weeks later.[17] The purpose of these two surveys was to test the effect of the nudge described in Section 2.4 and to prevent respondent fatigue by dividing other survey questions into two shorter interactions. We also used this pair of closely-spaced surveys to test whether students were able to find information on Wikipedia when incentivized to do so, by including an incentivized two-question general knowledge quiz, as described in detail in Derksen et al. (2022). We also conducted a long-run follow-up survey between 2023 and 2025, in which we attempted to reach former students five years after the intervention took place. The purpose of this survey was to investigate whether an early intensive introduction to Wikipedia affects long-run internet use patterns, and to collect descriptive data on health misconceptions before and after young people gain access to the full internet. The data collection involved recontacting participants who had since graduated from secondary school, using the contact details they provided in the original survey, and through social networks as needed. Most interviews took place over the phone, and some were conducted in person.[18] Appendix Figure A4 provides an overview of the timeline of data collection.

During the first endline survey in 2018, we asked students three multiple choice questions to capture knowledge related to common sexual health misconceptions. First, we asked about the length of a woman's fertile window during each menstrual cycle. Second, we asked about the HIV transmission rate. Third, we asked about the effectiveness of ART treatment in preventing HIV transmission. The wording of the questions and multiple choice options are presented in Appendix Table A2. Respondents also reported how certain they were about each answer. As described in Section 2.4, after the first end-

[17] About 5 percent of interviews took place less than two weeks after the first endline and less than 20 percent of interviews occurred six to nine weeks after.

[18] Only 11 surveys were conducted in person. In-person surveys were evenly distributed across treatment (6 treated and 5 control) and gender (4 young women and 7 young men). Controlling for survey mode does not meaningfully affect treatment effects on sensitive outcomes.

line survey we gave all students a piece of paper with the questions and multiple choices printed out.

During the second endline survey, we repeated the same three questions. During this second endline, we added a fourth question for which the students had not received a nudge to search. This additional question concerns another common misconception: that every sexual partner is equally risky regardless of age. Specifically, we asked about the likelihood of HIV-infection for men in different age groups (see Appendix Table A2). We again asked students how certain they were about their answer. In this second endline survey, for each knowledge question, we also asked students where they had learned the information.

The long-run follow-up survey covered a large number of outcomes. We repeated the four knowledge questions described above, as well as the certainty measures. Since these knowledge questions may not capture all of the relevant information young people use to inform their behavior, we added several new questions about sexual health behaviors. The long-run survey also included questions about attitudes towards sexuality and gender, gender norms and rights, access to the internet, and internet usage patterns.

We observe attrition at each follow-up survey. At the first endline, 95.2 percent of study participants responded to the survey. 91.7 percent responded to the second endline. 543 participants responded to both endline surveys (90.7 percent). In the long-run follow-up survey, 85.3 percent of the young people responded to the questionnaire (out of 599 potential respondents). We do not observe differential attrition by treatment status (see Panel B of Appendix Table A1).

4.2 Empirical Strategy

Our main regression specification for evaluating the short-term impact of Wikipedia access on health knowledge is as follows:

$$y_i = \alpha + \beta T_i + \sigma_s + \varepsilon_i \tag{1}$$

where y_i is the outcome of interest of individual i, α is a constant, T_i is a dummy variable indicating the treatment status, and σ_s is a stratum fixed effect. Our coefficient of interest is β, the estimated effect of Wikipedia access on the outcome of interest. ε_i is the error term. We present robust standard errors (Bruhn and McKenzie, 2009). To account for multiple hypothesis testing, we also include q-values following Anderson (2008), which controls for false discovery rates.

We also estimate heterogeneous treatment effects by gender in which we interact the treatment dummy variable with dummy variables that equal 1 if i is a male ($Male_i$) or female ($Female_i$) respondent:

$$y_i = \alpha + \beta^M T_i \times Male_i + \beta^F T_i \times Female_i + \delta Male_i + \sigma_s + \varepsilon_i \quad (2)$$

The analysis of the long-run data follows the same specification as equation 1, but includes a continuous time trend t_i capturing the month and year of the long-run follow-up survey, as follows:[19]

$$y_i = \alpha + \beta T_i + \sigma_s + t_i + \varepsilon_i \quad (3)$$

Our treatment effects are estimated following an analysis plan, with deviations from the analysis plan clearly noted in the text, with rationale for each deviation provided in Appendix D.[20] The analysis plan was prepared before long-run data collection was completed, but after short-run data was collected and analyzed for a separate paper (Derksen et al., 2022). The short-run health knowledge analyses were not pre-specified in detail, and are broadly classified under the secondary outcome category 'general knowledge' in the original registry. While these analyses may therefore be viewed as exploratory, we do include the complete set of sexual-health knowledge questions from the short-run surveys. The short-run results informed follow-up data collection: we hypothesized that Wikipedia access might shift internet usage and consequently knowledge, behaviors, and attitudes in the long-term. We provide a full chronology of funding, ethics approvals, data collection, and analysis plans in Appendix E, which is summarized in Appendix Figure E1.

4.3 Impact on Health Knowledge

Health Knowledge Outcomes

In the short run, we find that the vast majority of students in both the treatment and control groups remain misinformed about critical facts related to pregnancy and HIV risk. Panel A of Figure 4 shows the percentage of students who answer each sexual health question correctly, at the first endline survey, by treatment group. Overall, the great majority of respondents in the treatment and control groups answer incorrectly. This is particularly true for the common misconceptions surrounding HIV: for each of these questions, fewer than 5 percent of students answer correctly. Students are more informed when it comes to the Fertility question; 31 percent of control students answer this question correctly.

Access to Wikipedia does not significantly improve short-run knowledge of these key facts. Table 2 presents the point estimates from equation 1. Estimated effects are null or

[19] We pre-specified a specification that includes a time trend control as the follow-up data collection took approximately two years to complete. However, this control is potentially causally affected by treatment status. We include estimates of our main effects without the time trend in the appendix.

[20] We have also included descriptive facts and figures not specified in the analysis plan. Analysis plan available at https://www.socialscienceregistry.org/trials/3824.

negative for every knowledge question. Even taking 95 percent confidence intervals into account, it is unlikely that Wikipedia access leads to a meaningful number of students becoming informed. In the short-run, we can bound the effect size below 1 percentage point for knowledge of the true HIV transmission rate, below 5 percentage points for knowledge about HIV treatment as prevention, and below 12 percentage points for fertility knowledge. As a point of comparison, providing direct information about HIV transmission risk or ART treatment as prevention has been shown to increase the share of correct beliefs by more than 40 percentage points (Derksen et al., 2022; Kerwin, 2025). We find no short-run impact of Wikipedia access on a knowledge index, and can bound effects below 0.12 standard deviations. The Knowledge Index is constructed using all three or four knowledge questions, and following Anderson (2008). We present the results in Columns 1 and 3 of Table 3, which shows no impact on knowledge at the first endline.

Low levels of knowledge persist even after all students are given a soft nudge to search for the answer. At the first endline survey, both treatment and control groups were given a printout of the knowledge questions. Panel B of Figure 4 and Table 2 present the results for these same questions two to five weeks later, as well as the percentage of students who know that older men are more likely to be HIV positive (i.e., the Sugar Daddies question, which was added to the second endline). Again, for the HIV questions fewer than 5 percent of students answer correctly, and we can bound any positive effect below 2 percentage points.

In fact, female students in the control group are slightly more likely to learn the correct answer to the Fertility question between the first and second endline surveys than treatment students. Column 4 of Panel B in Table 2 shows that on average, relative to female students in the control group, female students with access to Wikipedia are significantly less likely to know the number of fertile days in an average menstrual cycle. Male students are also less likely to know the correct answer, but the difference is not statistically significant. While we also find a statistically significant negative effect in Column 7 (the Sugar Daddies question), only 1 percent of students (i.e., 6 students out of 549) answer the question correctly. We also estimate a negative and significant coefficient on the knowledge index at the second endline (Column 3 of Table 3). In Figure 5 we show that none of these estimates, nor any other treatment effect estimates reported in the paper, are statistically significant after adjusting for multiple hypothesis testing (Anderson, 2008).

The limited sexual health knowledge we document is remarkably persistent over time, even after participants gain access to the full internet. Five to seven years after the endline, we asked the same four knowledge questions to the young people in the survey sample. Panel C of Figure 4 shows a similar pattern to Panel B (the second endline survey), with the great majority of respondents answering incorrectly. We do see a

slight rise in knowledge about HIV treatment as prevention, a subject of recent global public health campaigns[21], in both the treatment and control groups over time. Table 4 presents the long-run point estimates for each question in Columns 1 to 4, as well as for the Knowledge Index in Column 5. All treatment effect estimates are statistically insignificant. Taking 95 percent confidence intervals into account, we can bound any positive effect below 4 percentage points for the fertility, HIV transmission rate, and Sugar Daddies questions, below 9 percentage points for treatment as prevention, and below 0.06 standard deviations on the index.

In contrast, providing correct information to all participants does appear to improve knowledge, particularly for the question citing a more credible source. Soon after eliciting beliefs for the first time in the long-run survey, we provided participants with the information they would need to answer two of the HIV questions correctly (see Section 2.4). We again elicit beliefs immediately after providing the information, and again after a 15-minute survey break. Figure 6 shows the percent of participants who answer correctly after being provided with correct information from the high-quality source (the UN, Panel A, ART Question) versus from social media (Twitter, Panel B, HIV transmission rate Question). In both cases, we see a significant jump in correct answers immediately after the information is provided, and a slight rise after the break. However, only the high-quality source persuades a majority of participants: 53 percent answer the question about ART correctly after information is provided, while the social media post increases the rate of correct responses from 2 percent to only 13 percent (15 percent after the break). While consistent with other research showing that direct health information provision can impact beliefs (Derksen et al., 2022; Dupas, 2011a; Kerwin, 2025), this descriptive evidence cannot be interpreted as strictly causal for three reasons. First, the information was delivered to all respondents, and the change in beliefs is a pre-post comparison. Second, the source of information (UN vs. Twitter) was not randomized across questions, for which respondents may have differential susceptibility to updating. Third, we phrase the ART knowledge question slightly differently after the information provision to better match the UN statement: "Do you believe that it is impossible for a person with an undetectable viral load to spread HIV?" We cannot rule out that this change in phrasing partly explains the large jump in correct beliefs after information provision.

Certainty and Misinformation

Respondents' answers to the knowledge questions suggest that beliefs about HIV are subject to specific, common misconceptions. Figures 7 to 10 show the exact multiple-choice answers chosen by the respondents. For the Fertility question (Figure 7), the most common choice is the correct answer at every time period. However, for each HIV-related

[21]See, for example, https://preventionaccess.com/.

question, the majority of respondents choose the same incorrect answer. At every survey point, approximately two-thirds of respondents believe the HIV transmission rate to be 100 percent, with most remaining respondents choosing 50 percent (Figure 8). In the short run, approximately four-fifths of students believe that HIV treatment has no effect on HIV transmission (Figure 9). And, in both the short and long run, the majority of respondents believe that older and younger men are equally likely to be HIV-positive (Figure 10).

Both treatment and control respondents report a high degree of certainty even over incorrect responses (see Appendix Table A5). Certainty over incorrect answers is high at the first endline (Panel A) and remains high at the second endline (Panel B) and the long-run follow-up survey (Panel C). HIV-related misconceptions are particularly strongly-held; for incorrect responses at the second endline survey, the respondent is *certain* or *very certain* 96 percent of the time. This is less true of the Fertility question, but most incorrect answers are still stated with certainty: 88 percent for girls and 97 percent for boys. Appendix Figures A5 to A7 present the source of information used to answer the knowledge questions, as reported by treatment and control students. For the Fertility question, both correct and incorrect answers come from a range of sources including teachers, the library, and Wikipedia. For the HIV questions this is also the case, but the most common source for both treatment and control students is a "guess".

Wikipedia access does not appear to affect the likelihood that a student has strongly-held but misinformed beliefs. We construct a Misinformation Index using indicator variables that equal one when the response is incorrect, and the respondent expresses certainty about their incorrect answer. As seen in Columns 2 and 4 of Table 3 and Column 6 of Table 4, the treatment effect estimates are insignificant in both the short term and long term.

4.4 Long-Run Impact on Sexual Behavior and Attitudes

Wikipedia access during secondary school may impact later sexual behavior and risk taking through various channels. In the previous section, we showed that Wikipedia access did not increase sexual health knowledge as measured by four key facts. Yet, the intervention may have affected knowledge along dimensions we did not measure, with possible implications for attitudes and behavior. In this section, we examine whether access to Wikipedia affected sexual behavior and attitudes, as well as internet use patterns in the long run.

Sexual Health Behavior

We do not find significant long-run effects of Wikipedia access on most sexual behavior measures, including teenage marriage and parenthood, unprotected sex, and HIV testing.

Table 5 presents treatment effect estimates for (1) having sex before age 18, (2) marriage before age 20, (3) becoming a parent before age 20, (4) unprotected sex in the past month, and (5) HIV testing in the past year (or has ever taken ART). We also construct an index (6) that includes all sexual behaviors from outcomes in Columns 1 to 4. Most point estimates are very close to zero overall, and for both male and female respondents separately. For example, we find a less than 1 percentage point increase in the probability of unprotected sex in the past month, from a control group rate of 38 percent, and with confidence interval $(-0.08, 0.10)$. This indicates that the intervention is unlikely to produce large reductions in risky sexual behavior in the long run, though for unprotected sex we cannot rule out reductions of up to 8 percentage points. We also find no significant impact on overall HIV risk behavior. Column 7 of Table 5 shows the effect on the HIV Risk Index, which includes the number of sexual partners in the past month, the total number of partners ever, and an indicator for unprotected sex in the last month. Male respondents in general are more likely to engage in risky behavior, but we do not find a significant treatment effect for either gender; the average treatment effect estimate is -0.04 standard deviations.

We do find a significant 8 percentage point decrease in the likelihood of sex before age 18, which contributes to a negative effect on the summary index measure in Column 6. The estimated relative decrease is similar for boys (58 percent) and girls (56 percent). The estimate is only significant for boys, who are slightly more likely overall to report having sex for the first time before 18 (Panel B of Table 5). These treatment effect estimates are not significant once we adjust for multiple hypothesis testing (Figure 5). The coefficients may be negative in part due to random imbalance: we observe that students in the treatment group were marginally less likely to have had sex before the intervention began (6 students, compared to 16 in the control group, a difference statistically significant at the 5 percent level as shown in Appendix Table A1).[22]

It should be noted that, unlike for beliefs measures, we do not have sufficient statistical power to rule out potentially meaningful effects on all sexual health measures. The ex ante minimum detectable effect size ranges from 2 percentage points (teenage marriage), to 4 percentage points (teenage parenthood), to 11 percentage points (unprotected sex, corresponding to a 28 percent relative increase). For indices, the minimum detectable effect size is 0.22 standard deviations.[23] Ex post, we can use 95 percent confidence intervals to bound the effect on teenage marriage below 2 percentage points, on teenage parenthood below 4 percentage points, on unprotected sex below 10 percentage points, on

[22]Appendix Table A6 disaggregates findings by whether the school was co-educational or single-sex. Across school types, sex before age 18 occurs at a similar rate (perhaps outside of term time), and the treatment effect estimates are also similar.

[23]We compute ex ante minimum detectable effects assuming 80 percent power, a 5 percent significance level, the full survey sample of 599 respondents, and that covariates explain 10 percent of the variation in each outcome.

HIV testing below 11 percentage points, and on the HIV Risk Index below 0.16 standard deviations. These bounds widen by roughly 1.4 times for estimates disaggregated by gender, leaving us underpowered to detect modest gender-specific effects. For comparison, Dupas (2011a) is able to detect a 1.5 percentage point decrease in pregnancy, an effect size we would not be powered to detect.

There is another reason to be cautious in interpreting the results of Table 5. The reported rates of sexual activity, even in the control group, are much lower than expected for a young adult in Malawi. For example, 18 percent of secondary-educated Malawian girls aged 15 to 19 report having been pregnant (DHS, 2024), while only 3 percent of girls in our sample report a pregnancy before age 20. This may be due to selection: students attending selective boarding schools may be less likely to engage in sexual behavior. Respondents may also underreport sexual activity due to social desirability bias (Bertrand and Mullainathan, 2001), though marriage and pregnancy are in some ways more objective and were cross-checked against marital status and number of children during the interview. Finally, many of the students in our sample graduated close to the start of the COVID-19 pandemic, which may have influenced social behavior. We should therefore be careful not to draw broad conclusions about the impact of online information on sexual behavior in Malawi and beyond.[24]

Attitudes Towards Sexuality and Gender

Given the amount of time spent browsing Wikipedia pages related to sex and sexuality, we might expect Wikipedia access to impact long-run attitudes towards sexuality and gender.

Overall, we find no significant long-run impact on attitudes towards LGBT people, progressive gender norms, or sex before marriage. Table 6 reports the treatment effect estimates on several indices that capture (1) whether respondents can correctly define what it means for someone to be LGBT or transgender,[25] (2) acceptance of same-sex relationships, (3) acceptance of transgender identity, (4) gender equality, and (5) acceptance of sex before marriage. All of the average treatment effect estimates are insignificant. However, female respondents in the treatment group are significantly more accepting of transgender people, and the point estimates on same-sex acceptance, gender equality, and

[24] In Appendix Table A7, we control for whether the follow-up survey was conducted in person (11 surveys). Survey mode may affect reporting of sensitive outcomes such as age at first sex (Column 1), unprotected sex (2), and HIV testing (3). We find that in-person respondents report higher rates of sex before 18 and unprotected sex, but lower rates of HIV testing in the past year. The treatment effects on these outcomes remain unchanged.

[25] Whether the respondents knew the definition of the acronym LGBT was recorded by the enumerators themselves. For the definition of transgender, we asked enumerators to provide the definition given by the respondent. The researchers manually assigned a score based on their answers, based on approximate adherence to the Merriam-Webster dictionary definition: "of, relating to, or being a person whose gender identity differs from the sex the person was identified as having at birth". We provide examples of respondents' definitions in Appendix Table A8.

attitudes towards sex before marriage, while insignificant, are large and positive. Again, all point estimates are statistically insignificant when adjusted for multiple hypothesis testing (Figure 5).

Given that Malawian laws prohibit same-sex relationships, young people may be hesitant to express support for LGBT people. Indeed, more than three-quarters of respondents state that being in a same-sex relationship, or being transgender is never justifiable (Panel A of Appendix Figure A8).[26,27] We observe substantially more variation in responses to questions about discrimination and criminalization of LGBT people, as well as abortion and gender roles (Panel B of Appendix Figure A8).

Internet Use

Finally, we examine whether the Wikipedia intervention led to long-run differences in internet use patterns. Table 7 shows treatment effect estimates on access to smartphones, internet use, Wikipedia use, and use of social media and other sources for health information. We find that the intervention had few long-lasting impacts on the use of smartphones, Wikipedia or the internet more broadly.[28] Almost all of the treatment effect estimates are insignificant overall and across genders.

While the treatment group is significantly more likely to report having ever used Wikipedia, 86 percent of the control group also reports having done so, and in both groups the average student visited 5 Wikipedia pages in the past week (based on self-reported browsing history). Treated students are slightly more likely to use Wikipedia for health information (0.07 standard deviations), and less likely to use social media (0.05 standard deviations), but these differences are not statistically significant. Social media use in general is similar across treatment and control groups. We do find that women in the treatment group are significantly more likely than women in the control group to access free internet (an outcome that was not pre-specified).[29]

[26]In-person respondents are less likely to report favorable attitudes towards same-sex relationships and gender diversity (Columns 4 and 5 of Appendix Table A7), but more likely to express support for gender equality (Column 6) and acceptance of premarital sex (Column 7). Treatment effects become marginally significant for attitudes towards transgender individuals (Column 5 in Panel A).

[27]In the analysis plan, we hypothesized, based in part on the browsing data (see Figure 3), that those who were more socially isolated during school may be more accepting of LGBT people later on. However, we do not find any significant correlation between having a below-median number of friends at baseline and LGBT acceptance (Appendix Table A9).

[28]Most of the outcomes in this table correspond with the outcomes specified in the study's analysis plan. However, there are two key changes. First, the outcomes for "has digital wellbeing", "free internet", and "has browsing history" were not pre-specified, but have been included after data exploration. Second, the "Social Media and Health" and "Wikipedia and Health" outcomes in Panel D were pre-specified to include the ranked position of social media or Wikipedia as inputs into their respective indices. This has been modified to include an indicator for whether this source was included as one of their top three sources, as many higher rank positions were missing due to a data collection error. This change has no impact on the findings, but makes the index more informative as we have fewer missing values. All deviations from the analysis plan are described in Appendix D.

[29]Appendix Tables A10 to A13 present the long-run results excluding the time trend. All results are

4.5 Discussion

Despite having access to an online information source with accurate, up-to-date health information, the students in our study did not gain critical knowledge required for family planning or to understand HIV infection risks. In this section, we shed light on two possible reasons why Wikipedia access is not effective in improving sexual health knowledge or behavior. First, because sexual health misconceptions are believed with a high degree of certainty, students may not bother to search for new information online. Second, even when restricted to Wikipedia, students prefer to spend their time reading lower-quality, but perhaps more entertaining content, and are more interested in sexuality than in sexual health. The limited knowledge gains we document do not appear to be driven by limitations of Wikipedia as an information source or by limits of understanding. On the contrary, students find Wikipedia to be engaging, easy to use, and trustworthy. It is worth noting that unlike our experimental estimates of the treatment effect, the evidence in this section is mostly descriptive and exploratory rather than causal.

Confidence in Common Misconceptions

The knowledge questions we posed are subject to widespread and strongly-held misconceptions, which may prevent people from seeking out true information. Across all three HIV questions, nearly every respondent consistently gets the answers wrong (Figure 4). Most of the incorrect answers are clustered around common misconceptions, including the misconception that HIV transmission is highly likely in a single act, and that every potential sexual partner is equally high-risk. These misconceptions are aligned with public health campaigns and school-based sex education programming which often emphasize HIV risk, as discussed in Section 2.1.

The vast majority of respondents in our study are confident that they already know the answers, even when incorrect. At the first endline survey, over 95 percent of incorrect respondents are certain they are correct (Appendix Table A5). After being prompted with the questions and receiving them in printed form, the students had several weeks to seek out the correct answers should they wish to. Yet, the pattern of incorrect responses and certainty is nearly identical at the second endline. Even at the long-run follow-up, 87 percent of incorrect respondents are certain they have the correct answer. This suggests that rather than not having considered these questions, people simply believe they already know the answers. Information about the fertile window, on the other hand, does not appear to be subject to a specific misconception. Respondents are generally more informed on the topic of fertility, and those who are misinformed at the first endline survey are slightly less certain. Some students in the control group improved their fertility knowledge between the two short-run endlines, suggesting that young people may be more

robust to excluding this control.

inclined to seek out answers to questions when they are less certain.

Providing correct information directly does appear to shift misconceptions, particularly when arising from a credible source. During the long-run survey, most students appear to genuinely believe the UN statement on HIV treatment as prevention, as recorded in repeated survey measures and high certainty scores (see Panels E and F of Table A5). The rate of correct answers and certainty scores rise further after students are given a 15 minute survey break. Participants were asked why they did or did not change their answers (Appendix Figure A9); the terms "searched", "internet", and "googled" are relatively more important in responses from people who update their answers to be correct after the break.[30] This suggests that internet access may act as a complement rather than a substitute for campaigns to combat misinformation directly.

Distraction Online

The fact that we do not see a positive impact on the fertility question, which is not as prone to strongly-held misconceptions as the HIV questions, suggests a second explanation: students are drawn to Wikipedia pages about sexuality and other general interest topics, many of which are low quality, rather than sexual health information pages. Indeed, Wikipedia may distract students and take time away from other types of learning. Between the first and second endline survey, female students in the control group were more likely to find the correct answer to the Fertility question than female treatment students, apparently by asking their teachers (Table 2 and Appendix Figure A5).

During the intervention, the average treatment student spent a great deal of time browsing Wikipedia (29 hours), and 78 percent of that time was spent on general interest topics rather than school syllabus topics (Derksen et al., 2022). Indeed, Derksen et al. (2022) find that while the intervention impacted English exam scores by encouraging reading, most other school subjects were not impacted. The average student spent 7 percent of browsing time on pages related to sex and sexuality, yet very little time was spent on pages directly related to pregnancy or HIV, let alone on the specific pages most relevant to the knowledge questions. Fewer than 15 percent of students visited the relevant pages for any particular HIV knowledge question, and the average student spent less than one minute on them. For example, true information about the HIV transmission rate could be found in a short and clear passage within the main "HIV/AIDS" page, which had 9,181 words in total. Yet, even conditional on visiting the page, the average student spent only 4 minutes reading it, enough to cover only 10 percent of the content. Instead, students spent more time on sexuality topics such as sexual activities and behaviors, pornography and adult magazines, and genital anatomy and function (Figure 2).

[30]The relative frequency of each term across groups is measured using term frequency-inverse document frequency, a common heuristic for how important a word is within one set of responses relative to that word's importance in the overall set of responses (Hvitfeldt and Silge, 2021).

Students spent a disproportionate amount of sex-related browsing time on lower-quality pages (61 percent). This is not true of school-related browsing; for pages related to the syllabus, the average student spent 58 percent of their time on good-quality pages. Moreover, the average student spent 47 minutes on Biology pages, a common favorite school subject, and a subject for which Derksen et al. (2022) do find improvements in learning. The average student spent only 3 minutes on HIV-related pages. This potentially reconciles the findings in Derksen et al. (2022) with the null effects on HIV knowledge presented here.

One interpretation of the findings is that HIV risk information is simply not of value to secondary school graduates in Malawi. Yet, HIV is the leading cause of death in Malawi,[31] and young women are at particularly high risk of infection, whether or not they attend secondary school (DHS, 2016). In our long-run follow-up data, approximately one third of women and half of men report unprotected sex in the past month. It is difficult to reconcile the serious threat posed by HIV with the lack of browsing on this topic, except to conclude that students believe themselves to be already fully informed, or are distracted by online content that is of less importance but more entertaining.

Assessing Alternative Explanations

It is unlikely that our findings are explained by the quality of Wikipedia as an information source, in terms of accessibility or information available. First, students did not find Wikipedia to be difficult or unreliable. Derksen et al. (2022) show, using a number of measures, that the students were able to use Wikipedia to find information quickly and reliably, and preferred Wikipedia to other information sources. In the appendix we reproduce a table from Derksen et al. (2022) showing that at endline, students in the treatment group found information on Wikipedia to be easy to find and understand (Appendix Table A14). In fact, for information about safe sex, most treated students prefer Wikipedia to both their school books and their teachers (see Appendix Figure A10).

Second, the information needed to correctly answer the sexual health knowledge questions was available on Wikipedia *during the intervention*, often on more than one page. As documented in Appendix Tables A3 and A4, the timing of a woman's fertile window appeared on at least ten different pages, and the per-act HIV transmission rate appeared on the "HIV/AIDS" page. These are among Wikipedia's higher-quality articles; the "HIV/AIDS" page, for instance, currently holds a GA-class rating, one of the highest a page can receive. A student could have found or inferred the answers to all four questions by visiting four clearly relevant pages, each of which would take 20 minutes, on average, to read in full. Yet, most students did not visit any page related to the HIV questions,

[31] https://data.who.int/countries/454

and the average student spent less than one minute per page.

Relatedly, students were unlikely to have avoided sexual health information out of concern about being observed. Their browsing was anonymous, as they were assured when the intervention was introduced, and they spent considerable time on more sensitive and potentially stigmatizing sexuality-related content (Figure 2).

While information on health risks can be complex, we do not believe that our findings can be explained by a lack of understanding. If students did not understand the questions asked, we would expect to see variation in responses and high reported uncertainty. Instead, responses are tightly clustered around common misconceptions, and expressed with confidence. Nearly all students are misinformed on the topic of HIV risk; this implies that most students report incorrect beliefs in any large subsample of students, including the set of above-median achievers and the set of students attending competitive national secondary schools. Misconceptions persist for several years after graduation. When students are provided with correct information, most appear to adjust their beliefs.

Alternatively, perhaps students did search for and find the required information online, but discarded it on the advice of more trusted sources or majority opinion. In this case, universal Wikipedia access (as opposed to access for a minority of students) might lead to a shift in consensus around common misconceptions. Yet, students report Wikipedia to be highly trustworthy (Appendix Table A14), and used it for both incentivized quizzes and to prepare for high-stakes academic exams (Derksen et al., 2022). Conflicting information should, at the very least, lead to more variation in responses across students or a decrease in certainty over time, neither of which appear in our data. This explanation is also inconsistent with the sharp rise in beliefs we observe after providing brief informative statements to participants. It is more likely that most students did not search for this information at all.

Relatedly, we must consider the likelihood of large information spillovers from treatment students to the control group in our study. Students were free to share information they had read online, and frequently did so (Derksen and Souza, 2025). In the context of HIV risk information, positive spillovers appear unlikely, as knowledge levels are near zero in both treatment and control groups, and many treatment effect estimates are in fact negative. For all of the HIV questions, fewer than 5 percent of students answer correctly in either group, with no increase in knowledge between short-term survey rounds. It remains possible that the null effect on fertility knowledge is partly explained by positive spillovers, though most control students who answered the question correctly named a teacher or the library as their source.

To test for spillovers directly, we use a baseline question asking students who they talk to about health to construct an undirected network, in which two students are linked if either names the other. In Panel C of Table 2, we re-estimate the short-run treatment effects controlling for each student's number of baseline links and the number that are

treated. The estimates are essentially unchanged, and the coefficient on treated baseline links is small and statistically insignificant for every question, providing no evidence of spillovers through pre-existing networks.

It is important to note that our specific knowledge questions do not capture all important knowledge related to sexual health, and that online information may impact sex-related knowledge, attitudes and behavior in ways we cannot measure. Derksen et al. (2022) do find a positive impact on Biology exam scores, which may partially reflect an increase in knowledge about pregnancy and HIV. Life Skills and Social Studies, while covering some related topics, primarily test students on local context and norms, and we do not see any impact on exam scores in these subjects (see Appendix Table A15 and Appendix Figures F1 to F7 in Appendix F). Beyond knowledge, all students, and LGBT students in particular, may benefit from learning about sexuality, and about topics that are taboo in Malawian society. More broadly, while internet access alone may not combat strongly-held misconceptions, it does impact general health knowledge across many dimensions (Toffolutti et al., 2020; Abbasi and Pongou, 2023).

5 Conclusion

This study shows that providing adolescents in Malawi with access to Wikipedia, a high-quality online information source, does not counteract critical misinformation about HIV and pregnancy risks. Misconceptions persist over years, despite widespread access to the broader internet into young adulthood (Table 7). Two factors may help explain this lack of impact: students' certainty in their existing beliefs, leading to limited engagement with relevant health information, and the breadth of other, more compelling, content available on platforms like Wikipedia. While access to a high-quality online source like Wikipedia may offer various benefits, in this setting it did not serve as a substitute for targeted and effective sex education to address ingrained misconceptions about sexual health.

Limitations of the study include the potential for spillovers between treatment and control students, the fact that the sample size does not allow us to estimate subgroup effects with high statistical power, and that sexual behavior data is self-reported. These limitations are mitigated by the fact that the responses to the knowledge questions are near-universally and persistently incorrect. It is possible that student responses are biased by a desire to appear prudent. However, the answers given by nearly all students are not only incorrect but extreme. While self-reported sexual behavior data may also be subject to some desirability bias, approximately one-third of female students, and half of male students report unprotected sex in the past month. Self-reported HIV testing rates are well below optimal for young adults, who should be tested at least once per year according to Malawian national guidelines.

Our findings suggest that to become correctly informed about sexual health risks,

young people may need access to effective sex education that combats misinformation directly. Simple information interventions have proven highly effective in this regard (Dupas, 2011a; Angrist et al., 2019; Derksen et al., 2022; Kerwin, 2025). The design and implementation of effective and scalable sex education programming, to reach not only students but also vulnerable out-of-school youth, remains an important subject for future research and policy evaluation. More broadly, future research should shed light on the causes of widespread and persistent health misinformation, as well as the potential for correct information to spread, impact beliefs, and affect health behavior.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process: During the preparation of this work the authors used Claude Code in order to find typos, repetition, errors and omissions in the text. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Tables

Table 1: Topic Model Coherence and Terms

Topic Label	Coherence	Prop. Good	Top 10 Terms
Adult Entertainment Industry	0.143	0.037	film, born, american, awards, adult, city, york, pornographic, award, films
BDSM and Fetish Culture	0.184	0.049	bdsm, bondage, fetish, play, fetishism, body, erotic, clothing, form, worn
Entertainment and Gender in Japan	0.032	0.130	women, japanese, male, term, dance, female, clubs, club, japan, strip
Gender and Sexuality Diversity	0.105	0.272	sexual, gender, people, gay, women, lgbt, sexuality, orientation, lesbian, social
Genital Anatomy and Function	0.104	0.080	penis, vagina, urethra, male, vulva, skin, blood, glans, labia, clitoris
HIV/AIDS and Infection	0.337	0.325	hiv, infection, disease, risk, aids, infections, symptoms, include, people, health
Human Reproduction	0.214	0.137	sperm, male, female, reproductive, human, semen, reproduction, species, egg, humans
Mythology, Religion, and Literature	0.064	0.236	character, series, love, greek, church, catholic, story, book, roman, god
Pornography and Adult Magazines	0.154	0.119	pornography, magazine, pornographic, erotic, published, adult, films, video, magazines, playboy
Pregnancy and Childbirth	0.233	0.176	pregnancy, birth, baby, medical, mother, women, childbirth, health, delivery, weeks
Sexual Activities and Behaviors	0.123	0.176	sexual, sex, activity, person, term, partner, intercourse, form, stimulation, orgasm
Sexual Violence and Abuse	0.137	0.196	rape, sexual, child, abuse, violence, victims, assault, united, women, victim
Sexuality and Legal Aspects	0.135	0.209	sex, prostitution, marriage, countries, legal, law, country, laws, women, united
Women's Reproductive Health	0.161	0.204	vaginal, cancer, women, menstrual, vagina, pain, uterus, symptoms, breast, include

Notes: This table summarizes the top ten terms associated with each of the sexuality-related topics from the topic model, based on the introductions from the Wikipedia pages. These terms have been used to define the label for each topic. Coherence is a measure of how often words in a topic are used together. Higher levels of coherence indicate that the terms in that topic are more frequently associated with one another. "Prop. Good" reports the proportion of pages within this topic that meet the definition of good-quality pages, based on a page being classified as B-class or better in Wikipedia's page classification system.

Table 2: Wikipedia Access and Health Knowledge

	First endline			2-5 weeks after first endline			
	(1) Fertility	(2) HIV	(3) ART	(4) Fertility	(5) HIV	(6) ART	(7) Sugar Daddies
Panel A: Average Treatment Effect							
Treatment	0.044	-0.005	0.018	-0.093**	0.006	-0.006	-0.021**
	(0.040)	(0.006)	(0.016)	(0.039)	(0.007)	(0.012)	(0.009)
Panel B: Heterogeneous Treatment Effect							
Treatment × male	0.053	-0.006	-0.000	-0.065	0.006	-0.018	-0.009
	(0.054)	(0.011)	(0.018)	(0.052)	(0.011)	(0.015)	(0.008)
Treatment × female	0.032	-0.004	0.039	-0.138**	0.008	0.010	-0.038**
	(0.061)	(0.004)	(0.027)	(0.060)	(0.009)	(0.018)	(0.018)
Mean control	0.313	0.007	0.028	0.414	0.004	0.022	0.022
Mean control - male	0.312	0.013	0.025	0.340	0.006	0.025	0.013
Mean control - female	0.315	0.000	0.032	0.518	0.000	0.018	0.035
Observations	567	569	569	549	549	549	549
Panel C: Spillover Specification							
Treatment	0.046	-0.005	0.018	-0.093**	0.006	-0.006	-0.021**
	(0.040)	(0.006)	(0.016)	(0.039)	(0.007)	(0.012)	(0.009)
Baseline links	0.009	-0.001	-0.004	0.006	-0.002	-0.001	-0.001
	(0.012)	(0.001)	(0.004)	(0.008)	(0.002)	(0.003)	(0.001)
Treated baseline links	-0.017	-0.001	0.019	-0.032	0.001	0.005	0.005
	(0.032)	(0.001)	(0.014)	(0.032)	(0.004)	(0.011)	(0.007)
Mean control	0.313	0.007	0.028	0.414	0.004	0.022	0.022
Observations	567	569	569	549	549	549	549

Notes: This table shows the average and heterogeneous treatment effects of access to Wikipedia on knowledge around key sexual health misconceptions at first endline (Columns 1 to 3) and two to five weeks after the first endline (Columns 4 to 7). In each column, the outcome is an indicator variable that equals one if the answer is correct. *Fertility* refers to the question about the timing of a woman's fertility window, *HIV* refers to the question about HIV transmission rates, *ART* refers to the question about the effectiveness of antiretroviral treatment in preventing HIV transmission, and *Sugar Daddies* refers to the question about the likelihood of HIV-infection for men by age. See Appendix Table A2 for the complete set of questions and their multiple-choice options. Panel A shows the average treatment effect and Panel B presents the heterogeneous effects by gender. Panel C tests for spillovers, controlling for *Baseline links*, the number of students named in response to *"Who do you talk to about health?"*, and *Treated baseline links*, both demeaned. Panel C was not pre-specified in the analysis plan. All regressions include a strata fixed effect. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Wikipedia Access, Knowledge and Misinformation Indices

	First endline		2-5 weeks after first endline	
	(1) Knowledge	(2) Misinformation	(3) Knowledge	(4) Misinformation
	Panel A: Average Treatment Effect			
Treatment	0.029	-0.016	-0.099**	0.040
	(0.046)	(0.051)	(0.039)	(0.045)
	Panel B: Heterogeneous Treatment Effect			
Treatment × male	0.005	0.023	-0.075	0.099*
	(0.071)	(0.060)	(0.047)	(0.055)
Treatment × female	0.058	-0.062	-0.130*	-0.039
	(0.060)	(0.086)	(0.069)	(0.075)
Mean control	0.000	0.002	0.000	0.001
Mean control - male	0.025	0.030	-0.047	0.024
Mean control - female	-0.032	-0.033	0.066	-0.031
Observations	569	568	549	549

Notes: This table shows the average and heterogeneous treatment effects of access to Wikipedia on knowledge around key sexual health misconceptions at first endline (Columns 1 and 2) and two to five weeks after the first endline (Columns 3 and 4). The outcome in Columns 1 and 3 is a knowledge index constructed using indicator variables on whether the three or four health questions asked are answered correctly. See Appendix Table A2 for the complete set of questions and their multiple choice options. The outcome in Columns 2 and 4 is an index constructed from indicator variables that equal one if the answer to the question is incorrect and the respondent is certain about their incorrect answer. All indices are constructed following Anderson (2008). Panel A shows the average treatment effect and Panel B presents the heterogeneous effects by gender. All regressions include a strata fixed effect. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Wikipedia Access and Long-Run Health Knowledge

	Knowledge Questions				Indices	
	(1) Fertility	(2) HIV	(3) ART	(4) Sugar Daddies	(5) Knowledge	(6) Misinformation
	Panel A: Average Treatment Effect					
Treatment	-0.051	0.012	0.024	-0.030	-0.033	0.032
	(0.044)	(0.014)	(0.030)	(0.022)	(0.048)	(0.054)
	Panel B: Heterogeneous Treatment Effect					
Treatment × male	-0.005	0.010	0.045	-0.046	-0.017	0.020
	(0.059)	(0.023)	(0.037)	(0.031)	(0.067)	(0.073)
Treatment × female	-0.114*	0.013	-0.002	-0.005	-0.055	0.043
	(0.068)	(0.013)	(0.052)	(0.027)	(0.071)	(0.083)
Mean control	0.382	0.016	0.121	0.076	-0.000	0.001
Mean control - male	0.338	0.029	0.079	0.101	-0.007	0.074
Mean control - female	0.436	0.000	0.174	0.045	0.008	-0.092
Observations	510	509	509	510	510	510

Notes: This table shows the average and heterogeneous treatment effects of access to Wikipedia on long-run knowledge around key sexual health misconceptions, disaggregated by gender. In Columns 1 to 4, the outcome is an indicator variable that equals one if the answer is correct. *Fertility* refers to the question about the timing of a woman's fertility window, *HIV* refers to the question about HIV transmission rates, *ART* refers to the question about the effectiveness of antiretroviral treatment in preventing HIV transmission, and *Sugar Daddies* refers to the question about the likelihood of HIV-infection for men by age. See Appendix Table A2 for the complete set of questions and their multiple-choice options. Outcomes in Columns 5 and 6 are indices constructed following Anderson (2008). Column 5 is a knowledge index constructed using indicator variables on whether the three or four health questions asked are answered correctly. Column 6 is an index constructed from indicator variables that equal one if the answer to the question is incorrect and the respondent is certain about their incorrect answer. Panel A shows the average treatment effect and Panel B presents the heterogeneous effects by gender. All regressions include a strata fixed effect and a time trend indicating the month-year of the long-run follow-up survey. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Wikipedia Access and Long-Run Sexual Health Behaviors

	Individual Outcomes					Indices	
	(1) Sex before 18	(2) Married before 20	(3) Pregnancy before 20	(4) Unprotected Sex	(5) Tested for HIV	(6) (1) to (4)	(7) HIV Risk
Panel A: Average Treatment Effect							
Treatment	-0.079***	-0.003	-0.016	0.013	-0.030	-0.093**	-0.038
	(0.028)	(0.005)	(0.011)	(0.046)	(0.041)	(0.043)	(0.060)
Panel B: Heterogeneous Treatment Effect							
Treatment × male	-0.115***	-0.001	-0.026*	-0.056	-0.054	-0.144**	-0.134
	(0.043)	(0.003)	(0.014)	(0.063)	(0.056)	(0.056)	(0.094)
Treatment × female	-0.040	-0.005	-0.002	0.046	-0.016	-0.033	0.060
	(0.034)	(0.015)	(0.020)	(0.067)	(0.064)	(0.077)	(0.074)
Mean control	0.141	0.008	0.025	0.384	0.699	-0.002	-0.004
Mean control - male	0.198	0.000	0.023	0.482	0.732	0.058	0.177
Mean control - female	0.072	0.019	0.029	0.280	0.658	-0.078	-0.223
Observations	497	493	481	458	509	511	499

Notes: This table shows the average and heterogeneous treatment effects of access to Wikipedia on long-run sexual health behaviors, disaggregated by gender. The outcome in Column 1 is an indicator variable that equals one if the respondent declared having sex before 18 years old. In Columns 2 and 3, the outcomes are respectively indicator variables that equal one if the respondent was (2) married, or (3) had a pregnancy (or impregnated someone) before 20 years old. In Column 4, the outcome is an indicator variable that equals one if the respondent declared having unprotected sex in the past month. In Column 5, the outcome is an indicator variable that equals one if the respondent declared testing for HIV in the past year or ever taken antiretroviral therapy (ARVs or ART). Outcomes in Columns 6 and 7 are indices constructed following Anderson (2008). Column 6 is a combination of all the outcomes from Columns 1 to 4. Column 7 is constructed using information on the total number of sexual partners in their life, the number of sexual partners in the past month, and an indicator variable that equals one if they had unprotected sex in the past month. Panel A shows the average treatment effect, and Panel B presents the heterogeneous effects by gender. All regressions include a strata fixed effect and a time trend indicating the month-year of the long-run follow-up survey. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Wikipedia Access and Long-Run Attitudes towards Sex, Gender Diversity, and Norms

	Definition Index	Acceptance Indices			
	(1)	(2) Same-sex relationships	(3) Transgender	(4) Gender Norms	(5) Sex Before Marriage
Panel A: Average Treatment Effect					
Treatment	-0.034	0.003	0.114	0.031	-0.286
	(0.067)	(0.056)	(0.070)	(0.050)	(0.339)
Panel B: Heterogeneous Treatment Effect					
Treatment × male	-0.002	-0.074	-0.017	-0.046	-0.724
	(0.095)	(0.079)	(0.094)	(0.069)	(0.478)
Treatment × female	-0.076	0.092	0.268***	0.138*	0.359
	(0.096)	(0.081)	(0.103)	(0.079)	(0.478)
Mean control	-0.001	0.000	-0.001	0.000	4.625
Mean control - male	-0.021	0.073	0.082	0.030	4.935
Mean control - female	0.024	-0.092	-0.105	-0.038	4.236
Observations	510	510	510	510	507

Notes: This table shows the average and heterogeneous treatment effects of access to Wikipedia on long-run attitudes towards sexuality and gender, disaggregated by gender. Outcomes in Columns 1 to 4 are indices constructed following Anderson (2008). The outcome in Column 1 uses categorical variables on whether the respondent can correctly define LGBT and transgender. See Appendix Table A8 for examples of definitions provided by the respondents. The outcome in Column 2 includes three distinct variables taking a value between 1 (never justified) and 10 (always justified) regarding homosexuality, homosexuality between two adult men, and between two adult women, and two variables ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that homosexual activity should not be criminalized and whether same-sex marriage should be legalized. The outcome in Column 3 includes two distinct variables taking a value between 1 (never justified) and 10 (always justified) regarding the acceptability of a person born male who lives and dresses like a woman, and of a person born female who lives and dresses like a man; and one variable ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that a person born male who lives like a woman should be free to dress as a woman at work without facing discrimination. The outcome in Column 4 includes one variable taking a value between 1 (never justified) and 10 (always justified) regarding abortion, and two variables ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that men make better executives than women (reversed score) and whether a husband should help his wife with household chores. See Appendix Figure A8 for the distribution of these measures in the full sample. Finally, the outcome in Column 5 takes a value between 1 (never justified) and 10 (always justified) regarding sex before marriage. All regressions include a strata fixed effect and a time trend indicating the month-year of the long-run follow-up survey. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Wikipedia Access and Long-Run Internet Use

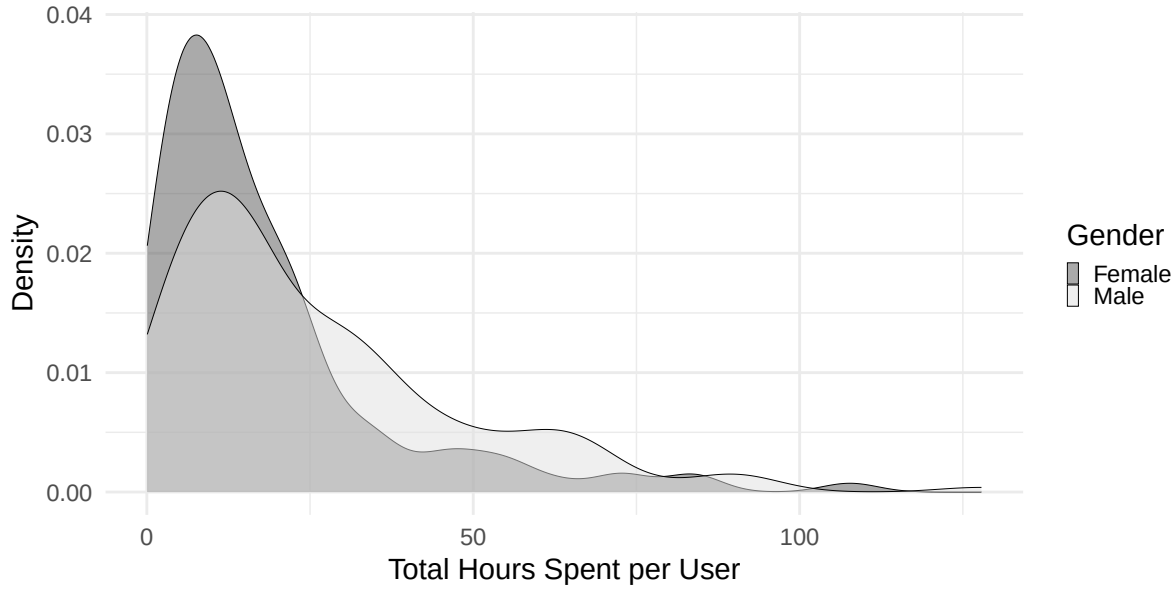
	Panel A: Access to a Smartphone		
	(1) Had Phone Before 20	(2) Minutes on Phone	(3) Has Digital Wellbeing
Treatment	0.033	2.196	-0.009
	(0.040)	(21.769)	(0.044)
Treatment × male	0.024	-14.040	-0.086
	(0.057)	(34.014)	(0.058)
Treatment × female	0.061	21.037	0.090
	(0.057)	(26.996)	(0.071)
Mean control	0.604	271.761	0.440
Mean control - male	0.518	257.630	0.424
Mean control - female	0.712	289.246	0.459
Observations	511	270	511
	Panel B: Internet Use		
	Days on Internet	Internet Bundles	Free Internet
Treatment	-0.065	-1033.239	0.073*
	(0.207)	(701.050)	(0.042)
Treatment × male	-0.327	-788.790	0.004
	(0.301)	(1016.176)	(0.055)
Treatment × female	0.339	-1484.054	0.180***
	(0.269)	(944.840)	(0.065)
Mean control	5.560	7020.014	0.402
Mean control - male	5.439	7130.219	0.403
Mean control - female	5.712	6868.333	0.400
Observations	510	442	509
	Panel C: Wikipedia Use		
	Used Wikipedia	Wikipedia Pages	Has Browsing History
Treatment	0.080***	-0.212	-0.032
	(0.027)	(0.788)	(0.041)
Treatment × male	0.062*	0.909	-0.029
	(0.034)	(0.695)	(0.058)
Treatment × female	0.096**	-0.908	-0.019
	(0.042)	(1.298)	(0.055)
Mean control	0.855	5.130	0.644
Mean control - male	0.885	2.486	0.518
Mean control - female	0.818	7.270	0.802
Observations	510	325	511
	Panel D: Social Media, Wikipedia, and Health		
	Social Media Usage	Social Media and Health	Wikipedia and Health
Treatment	0.002	-0.054	0.071
	(0.036)	(0.052)	(0.066)
Treatment × male	-0.033	-0.032	0.113
	(0.047)	(0.068)	(0.089)
Treatment × female	0.039	-0.076	0.056
	(0.060)	(0.083)	(0.098)
Mean control	0.021	-0.000	-0.001
Mean control - male	-0.007	-0.035	-0.132
Mean control - female	0.057	0.043	0.165
Observations	510	510	510

Notes: This table shows the average and heterogeneous treatment effect of access to Wikipedia on long-run internet use, disaggregated by gender. Panel A. Access to smartphone: (1) Owned phone before 20 years old; (2) Minutes on smartphone last Wednesday/Saturday; (3) Has Digital Wellbeing Panel B. Internet usage: (1) Days they used the internet over the past week; (2) Amount spent in Malawian Kwacha on internet bundles; (3) Accessed internet for free in the past month. Panel C. Wikipedia usage: (1) Ever used Wikipedia; (2) Number of Wikipedia pages they looked at in the past week; (3) Have browsing history. Panel D. Social media usage and online information on health. All indices are constructed following Anderson (2008): (1) Amount spent on social media bundles, minutes using social media last Wednesday/Saturday, how often they used social media in the past month, and have social media accounts (Facebook, Twitter, Tiktok, and WhatsApp); (2) Use social media for information about health and social media in top 3 best place to find information about health; (3) Use Wikipedia for information about health and Wikipedia in top 3 best place to find information about health. Outcomes in Columns 3 from Panels A, B, and C were not pre-specified in the analysis plan. All regressions include a strata fixed effect and a time trend indicating the month-year of the long-run follow-up survey. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

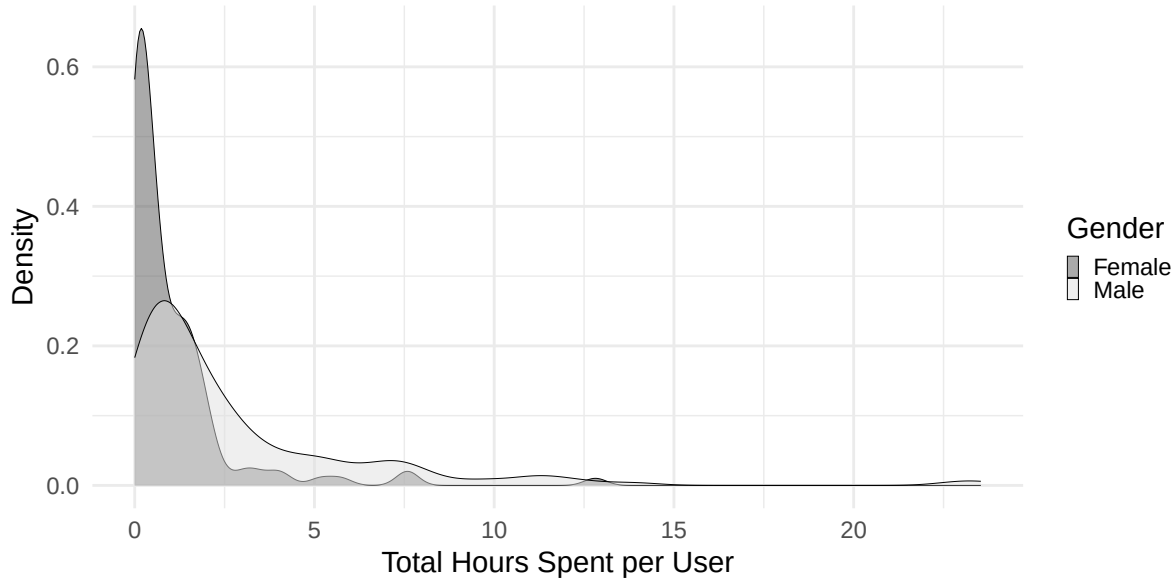
Figures

Figure 1: Browsing Time on Wikipedia Pages

Panel A. All Wikipedia Pages

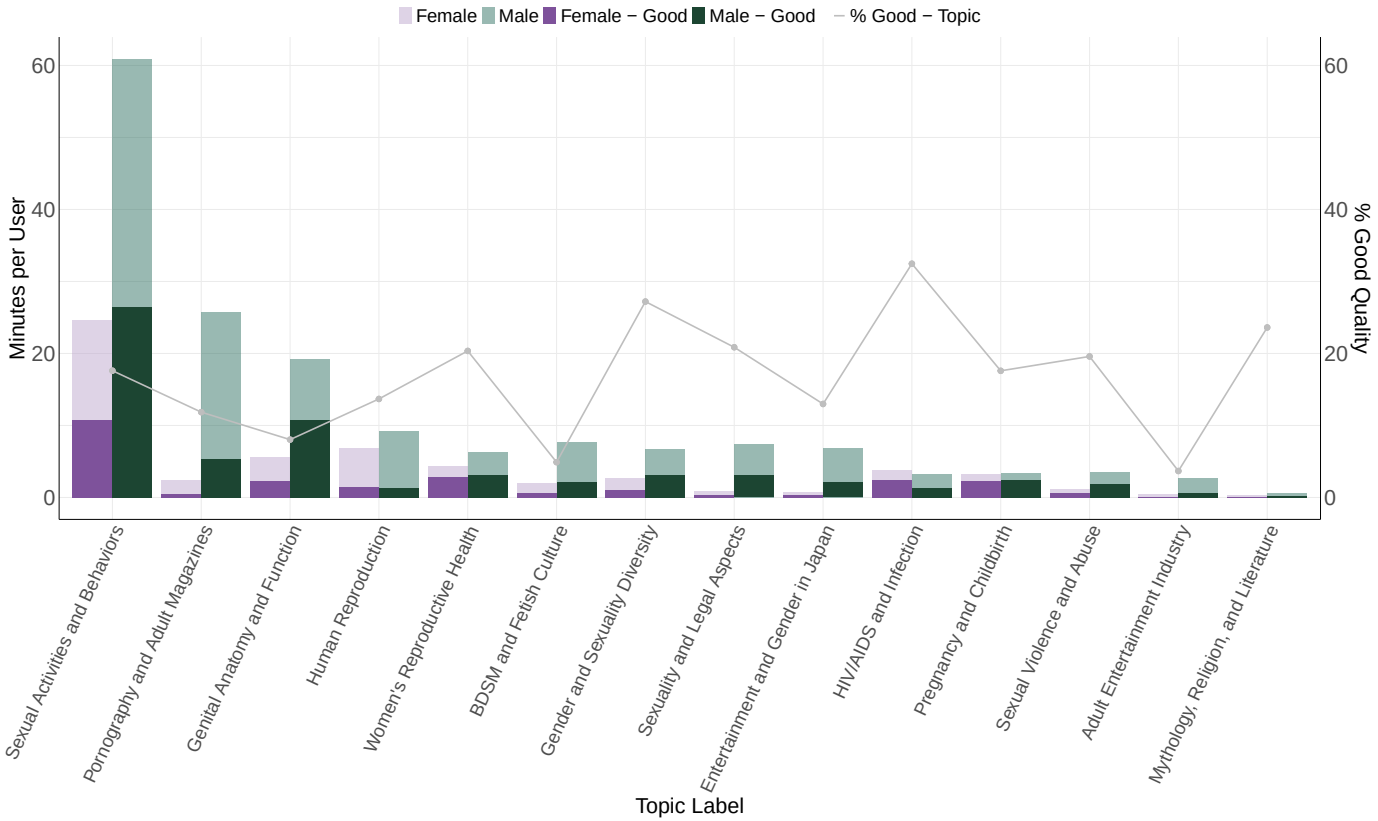


Panel B. Sex-Related Pages



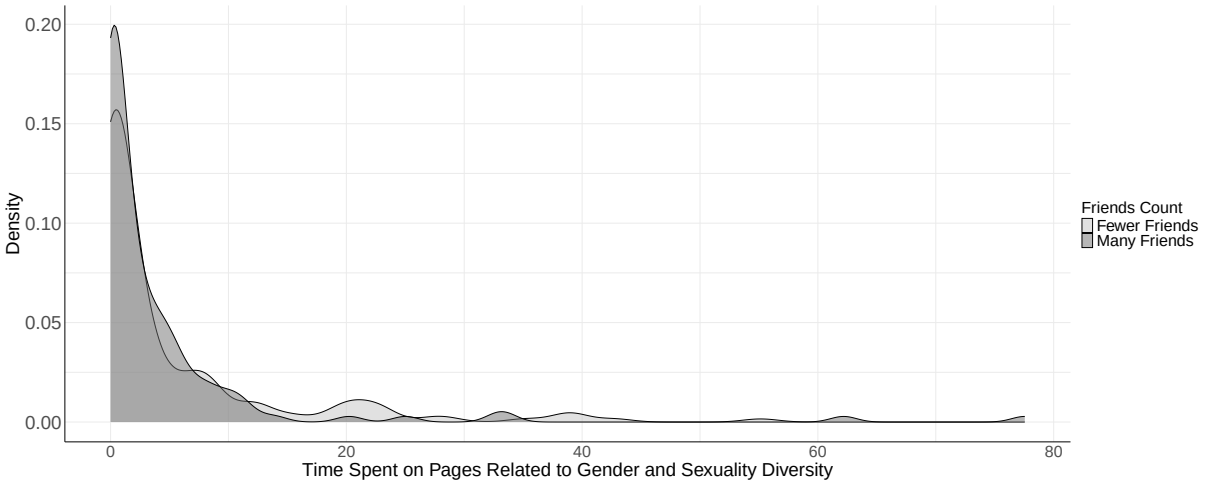
Notes: This figure shows the total amount of time students in the treatment group spend on all pages (Panel A) and on pages related to sex and sexuality-related topics (Panel B).

Figure 2: Browsing Time and Quality on Sex-Related Pages



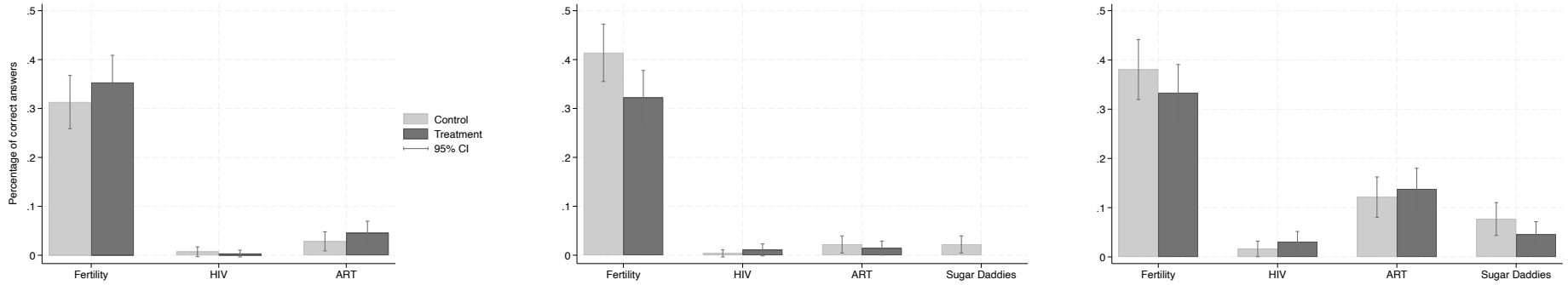
Notes: This figure shows the total amount of time students in the treatment group spend on pages related to different sex and sexuality-related topics and the average quality of pages in each of these topics. Within each bar, the darker portion represents the amount of time all treated students spent on good-quality pages. The page quality measure refers to pages that are assigned B-class or higher by Wikipedia editors, indicating the page is mostly complete and does not contain substantial errors. The solid grey line describes the average quality of pages in each respective topic. Topics are ranked from left to right according to the average number of minutes students spent on the topic.

Figure 3: Distribution of Time Spent per User on Topics Related to Gender and Sexuality Diversity



Notes: This figure shows the total amount of time students in the treatment group spent on Wikipedia pages related to "Gender and Sexuality Diversity," according to our topic model. The darker curve shows the distribution of time spent on these pages by students who are more socially isolated (i.e., they have "fewer friends" compared to the median number of friends reported at the beginning of the intervention). The lighter curve shows the distribution for students who had more than the median number of friends at the beginning of the intervention.

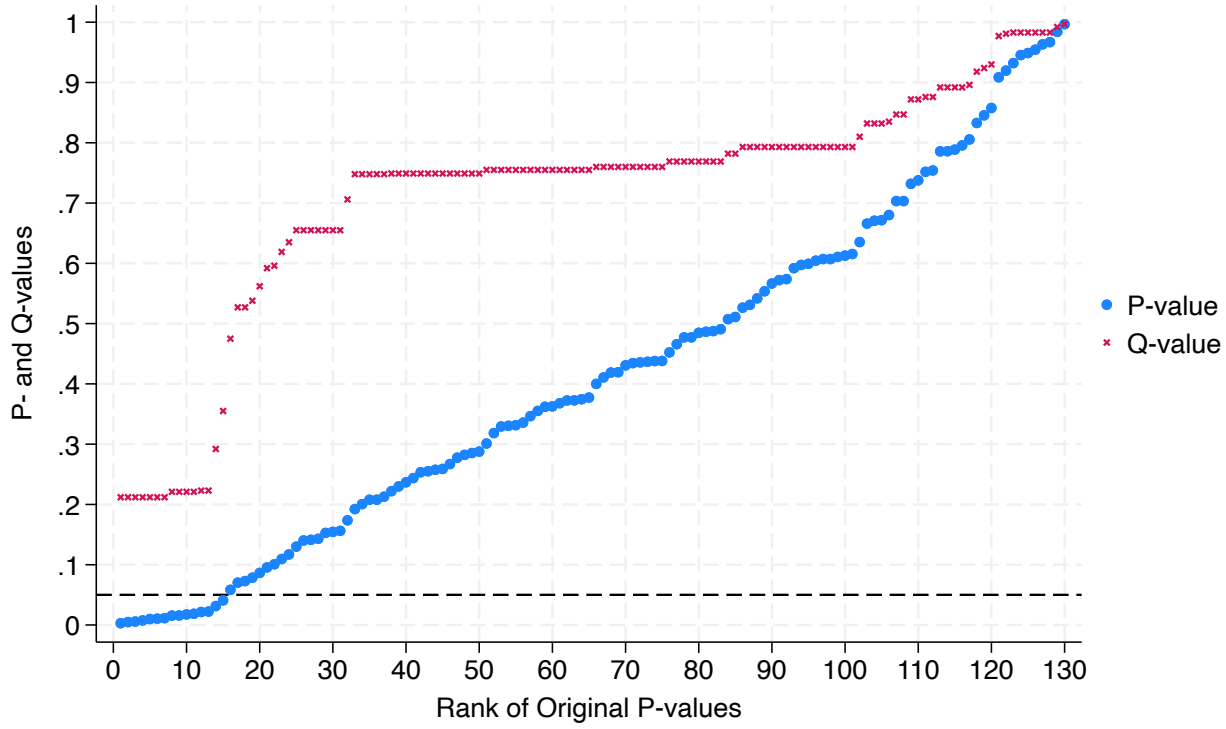
Figure 4: Knowledge by Treatment Group



A. First endline B. Two to five weeks later C. Five to seven years later

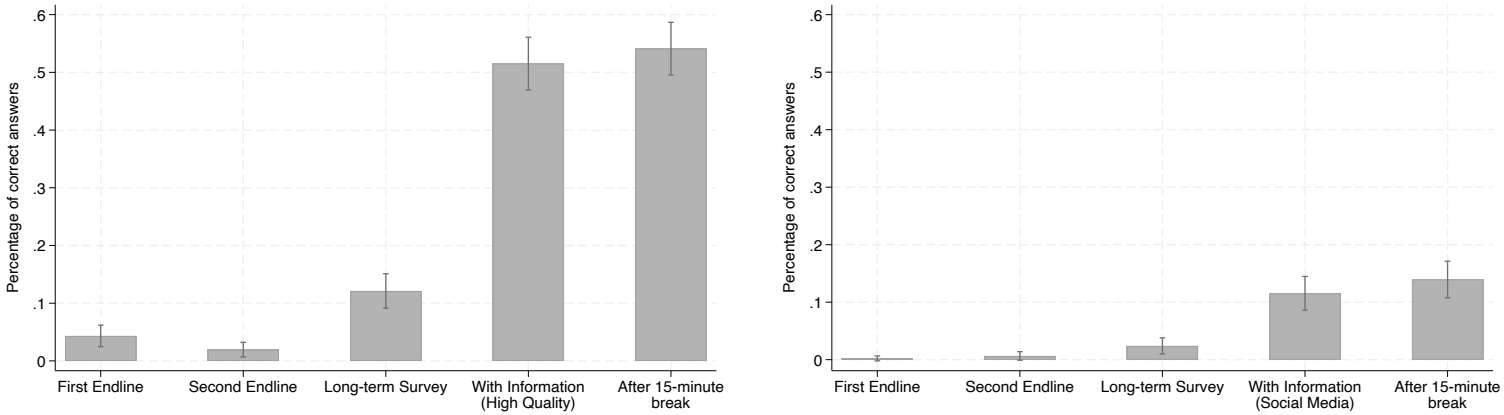
Notes: This figure shows the percentage of correct answers by treatment status at first endline (Panel A), two to five weeks after the first endline (Panel B), and five to seven years after the intervention (Panel C). The darker bar shows the percentage of correct answers for treated students and the lighter bar is for students in the control group. *Fertility* refers to the question about the timing of a woman's fertility window, *HIV* refers to the question about HIV transmission rates, *ART* refers to the question about the effectiveness of antiretroviral treatment in preventing HIV transmission, and *Sugar Daddies* refers to the question about the likelihood of HIV-infection for men by age. See Appendix Table A2 for the complete set of questions and their multiple-choice options. Confidence intervals at the 95 percent level are displayed.

Figure 5: P- and Q-values



Notes: This graph plots p-values and false-discovery-rate (FDR) q-values, following Anderson (2008). These are calculated across the full set of estimates in the paper (i.e., Tables 2 to 7), including estimates of heterogeneous treatment effects.

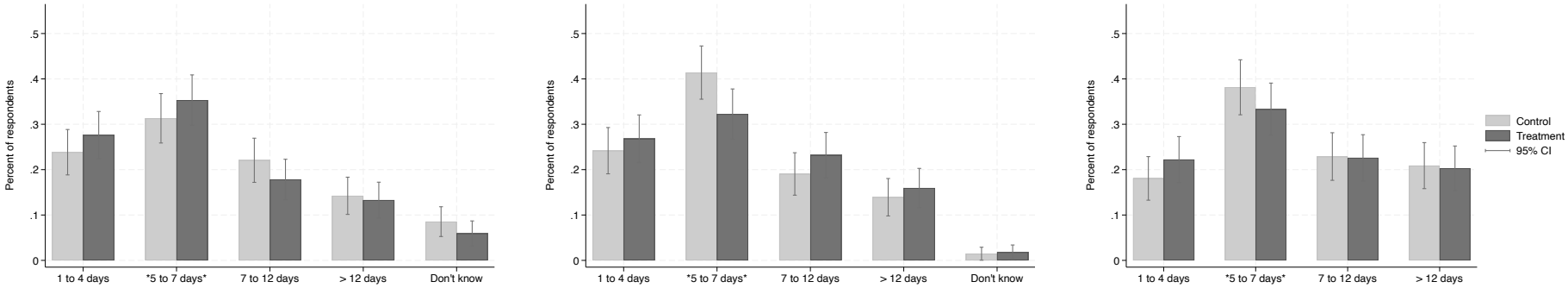
Figure 6: Percentage of Correct Answers - ART and HIV Questions with Information



A. ART Question B. HIV Question

Notes: This figure shows the percentage of respondents who correctly answered the ART and HIV Questions. *Second Endline* took place two to five weeks after the *First Endline* in 2018. *Long-run Survey* is the percentage of correct answers in the long-run survey without any prompts or information. *With Information* is the percentage of correct answers after receiving information on the correct answer (from the United Nations (UN) for the ART Question and from an anonymous Twitter user for the HIV Question) and *After 15-minute Break* is their answers after taking a break in the long-run survey right after the *With Information* responses. See Appendix Table A2 for the complete set of questions and their multiple-choice options. The information provided for the ART Question was: "According to the United Nations, people with HIV who achieve an undetectable viral load through ARVs – it is impossible for those people to transmit HIV." The ART knowledge question is phrased slightly differently after the information provision to better match the UN statement:"Do you believe that it is impossible for a person with an undetectable viral load to spread HIV?" The information for the HIV Question was: "I want to read you a post I found from an anonymous Twitter user: "The truth is that it's not nearly that easy to get HIV – the medical literature estimates that the transmission rate is actually about 0.1% per sex act."" The HIV Question was not rephrased.

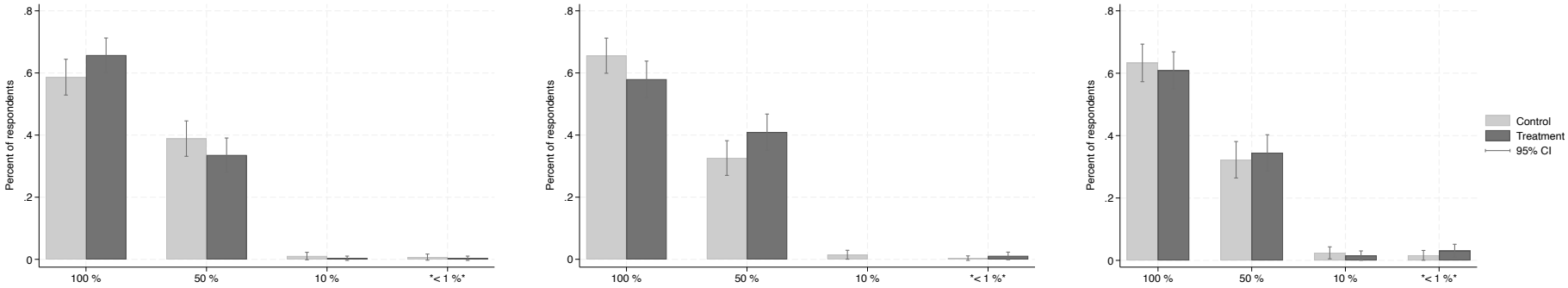
Figure 7: Answers to Fertility Question by Treatment Group (Correct Answer: **5 to 7 days**)



A. First endline B. Two to five weeks later C. Five to seven years later

Notes: This figure shows the distribution of the answers by treatment status to the *Fertility* question on the timing of the fertile window for women at the first endline (Panel A), two to five weeks later (Panel B), and five to seven years later (Panel C). See Appendix Table A2 for the complete question and its multiple-choice options. The darker bar shows the percentage of correct answers for treated students and the lighter bar is for students in the control group. Confidence intervals at the 95 percent level are displayed.

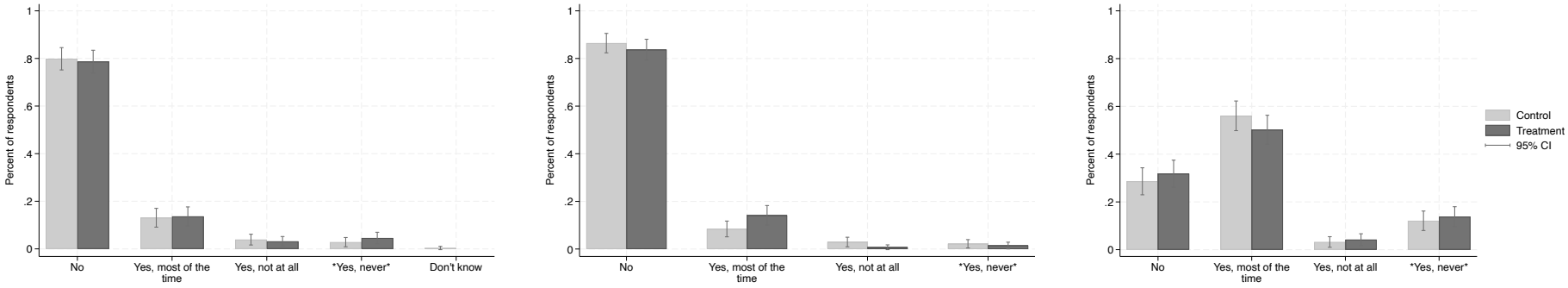
Figure 8: Answers to HIV Question by Treatment Group (Correct Answer: *<1%*)



A. First endline B. Two to five weeks later C. Five to seven years later

Notes: This figure shows the distribution of the answers by treatment status to the *HIV* question on the HIV transmission rate at the first endline (Panel A), two to five weeks later (Panel B), and five to seven years later (Panel C). See Appendix Table A2 for the complete question and its multiple-choice options. The darker bar shows the percentage of correct answers for treated students and the lighter bar is for students in the control group. Confidence intervals at the 95 percent level are displayed.

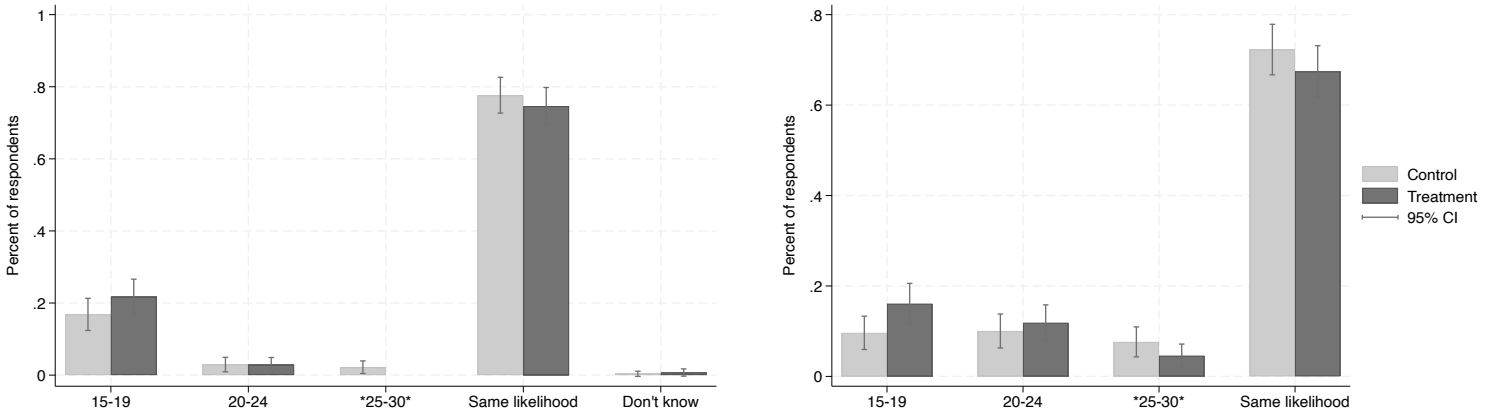
Figure 9: Answers to ART Question by Treatment Group (Correct Answer: **Yes, never**)



A. First endline B. Two to five weeks later C. Five to seven years later

Notes: This figure shows the distribution of the answers to the *ART* question on the role of antiretroviral treatment in preventing HIV transmission at the first endline (Panel A), two to five weeks later (Panel B), and five to seven years later (Panel C). See Appendix Table A2 for the complete question and its multiple-choice options. The darker bar shows the percentage of correct answers for treated students and the lighter bar is for students in the control group. Confidence intervals at the 95 percent level are displayed.

Figure 10: Answers to "Sugar Daddies" Question by Treatment Group (Correct Answer: **25-30**)



A. Second endline

B. Five to seven years later

Notes: This figure shows the distribution of the answers to the *Sugar Daddies* question on likelihood of HIV-infection for men by age at the second endline (Panel A) and five to seven years later (Panel B). See Appendix Table A2 for the complete question and its multiple-choice options. The darker bar shows the percentage of correct answers for treated students and the lighter bar is for students in the control group. Confidence intervals at the 95 percent level are displayed.

A Appendix Tables and Figures

Appendix Tables

Appendix Table A1: Balance and Attrition in Survey Sample

	Treatment		Control		
	(1) Mean	(2) SD	(3) Mean	(4) SD	(5) P-value
			Panel A. Balance		
Average exam score in English	57.188	13.187	57.626	13.533	0.694
Average exam score in Biology	53.810	17.196	53.267	17.640	0.709
Average exam score in Life Skills	66.077	16.080	64.984	14.907	0.500
Average exam score in Social Studies	67.993	17.251	67.098	16.544	0.653
Age	15.973	1.971	16.060	1.845	0.577
Female	0.452	0.499	0.433	0.496	0.641
District of origin	0.605	0.490	0.574	0.495	0.444
Mother's education	0.746	0.436	0.698	0.460	0.224
Father's education	0.849	0.359	0.852	0.356	0.918
Household has electricity	0.611	0.488	0.557	0.498	0.179
Household has a mobile phone	0.870	0.336	0.849	0.359	0.451
Has past Internet experience	0.512	0.501	0.507	0.501	0.902
Has past Wikipedia experience	0.098	0.297	0.098	0.297	1.000
Enrolled in health club	0.150	0.357	0.151	0.359	0.959
Number of health links	1.362	1.230	1.497	1.277	0.190
Fair for husband to beat wife	0.047	0.211	0.057	0.232	0.562
Woman's priority should be family	0.522	0.500	0.493	0.501	0.489
Women as able as man to lead country	0.906	0.292	0.930	0.256	0.303
Sex before intervention and 18	0.024	0.152	0.066	0.249	0.023
			Panel B. Attrition		
First endline	0.047	0.211	0.050	0.219	0.653
Second endline	0.083	0.276	0.084	0.278	0.933
Long-term survey	0.133	0.340	0.161	0.368	0.362
Number of Students	301		298		

Notes: Panel A: Balance table across the treatment (N=301) and control (N=298) groups in the survey sample. District of origin equals 1 if the student's home district is the same as the school district. Mother's and father's education equal 1 if the parent has completed primary education. Enrolled in a health club equals 1 if the student planned to participate in a health-related club such as the Red Cross, Age Africa, FHI, or Why Wait. Number of health links is the number of friends at baseline with whom the student talked about health. The last three variables on gender norms equal 1 if the student agrees with each statement. Sex before intervention and 18 is an indicator for having had sex both before the intervention began and before age 18, constructed from age at baseline and recalled age at first sex during the long-run survey, and therefore available only for respondents to the long-run survey. Panel B: Attrition rates in the treatment and control groups. Column 5 shows the p-value for the difference between treatment and control from a regression of the outcome on treatment status, with strata fixed effects.

Appendix Table A2: Questions and Multiple-Choice Options on Health Information Questions

Label	Question	Multiple-choice options
Fertility	Imagine a woman who has a menstrual cycle every month. She will be fertile on certain days every month. This is called the fertile window. That means if she has sex on those days, she might get pregnant. How many fertile days does an average woman have every cycle?	(a) 1-4 days **(b) 5-7 days** (c) 7-12 days (d) More than 12 days (e) Don't know (f) Refuse to answer
HIV	I want to ask you about the HIV transmission rate. Imagine an HIV-positive man who is NOT on treatment (ARVs) has unprotected sex with an HIV-negative woman one time. What is the approximate chance that she gets HIV?	(a) 100% chance – she will definitely get HIV (b) 50% chance – she has a 50/50 chance of getting HIV (c) 10% chance – in a single time she will probably not get HIV **(d) Less than 1% chance – in a single time she will probably not get HIV** (e) Don't know (f) Refuse to answer
ART	Do you think ARVs can stop a person living with HIV from spreading the virus?	(a) No (b) Yes, ARVs can reduce the chance of spreading the virus but most of the time the virus will still spread (c) Yes, as soon as a person starts taking ARVs they cannot spread the virus at all **(d) Yes, a person who has been taking ARVs properly for a long time will almost never spread the virus** (e) Don't know (f) Refuse to answer
Sugar Daddies	Who is the most likely to be HIV-positive?	(a) A teenage boy aged 15-19 (b) A man aged 20-24 **(c) A man aged 25-29** (d) They all have the same likelihood (e) Don't know (f) Refuse to answer

Notes: This table presents the four questions asked at the two endlines and in the long-run follow-up survey, the multiple choice options that the respondent could select, and the correct answer highlighted in bold.

Appendix Table A3: Pages with Content Relevant to the Fertility Question

Page	Relevant Section in Page (During Intervention)	Key Statement (During Intervention)	Page Length (Words)	Unique Users	Minutes per Treated Student
Menstruation	(intro)	(diagram)	3,358	106	1.05
Pregnancy	Chronology	(diagram)	5,983	98	0.86
Menstrual cycle	Cycles and phases	The typical length of time between the first day of one period and the first day of the next is 21 to 45 days in young women and 21 to 35 days in adults (an average of 28 days). Menstruation stops occurring after menopause which usually occurs between 45 and 55 years of age. Bleeding usually lasts around 2 to 7 days. [...] Approximately mid-cycle, 24–36 hours after the luteinizing hormone (LH) surges, the dominant follicle releases an ovocyte, in an event called ovulation. After ovulation, the ovocyte only lives for 24 hours or less without fertilization while the remains of the dominant follicle in the ovary become a corpus luteum.	4,688	92	1.11
Sperm	Sperm in animals	Human sperm cells can survive within the female reproductive tract for more than 5 days post coitus.	1,677	82	0.23
Ovulation	In humans	The few days surrounding ovulation (from approximately days 10 to 18 of a 28-day cycle), constitute the most fertile phase.	1,298	30	0.10
Fertility	Fertility biology	The ovule is usually capable of being fertilized for up to 48 hours after it is released from the ovary. Sperm survive inside the uterus between 48 and 72 hours on average, with the maximum being 120 hours (5 days).	1,749	22	0.10
Fertility awareness	Fertility signs	Most menstrual cycles have several days at the beginning that are infertile (pre-ovulatory infertility), a period of fertility, and then several days just before the next menstruation that are infertile (post-ovulatory infertility). The first day of red bleeding is considered day one of the menstrual cycle. Different systems of fertility awareness calculate the fertile period in slightly different ways, using primary fertility signs, cycle history, or both.	2,875	4	0.02
Calendar-based contraceptive methods	Types and effectiveness	Most menstrual cycles have several days at the beginning that are infertile (pre-ovulatory infertility), a period of fertility, and then several days just before the next menstruation that are infertile (post-ovulatory infertility)...	1,979	4	0.07
Luteinizing hormone	Predicting ovulation	A conversion from a negative to a positive reading would suggest that ovulation is about to occur within 24–48 hours, giving women two days to engage in sexual intercourse or artificial insemination with the intention of conceiving. [...] sperm can stay viable in the woman for several days.	1,526	4	0.01
Billings ovulation method	Fertility	A woman typically ovulates at only one time during her cycle (except those with hyperovulation), and an unfertilized ovum can survive for only 12-24 hours. Cervical mucus enabling healthy sperm cells to navigate the genital tract is necessary for fertility. Most commonly, spermatozoa live only one to three days in the presence of fertile mucus, with survival up to five days being rare. The possibility of pregnancy from sperm survival longer than five days has been compared to "the chances of winning a huge lottery."	1,312	1	0.00
Total				**193**	**3.56**

Notes: This table displays pages that contain information relevant to the *Fertility* question, along with the key section and statements from which the answer could be found or inferred in historical versions of the page available during the intervention. These historical versions of pages were reviewed using the Internet Archive "Wayback Machine". The last two columns show how many students in the treatment group looked at each of these pages, and how much time students spent on each page on average across the treatment group during the 8-month period when the digital libraries were open (November 2017 to June 2018).

Appendix Table A4: Pages with Content Relevant to the HIV-related Questions

Page	Relevant Section in Page (During Intervention)	Key Statement (During Intervention)	Page Length (Words)	Unique Users	Minutes per Treated Student
HIV					
HIV/AIDS	Transmission	In low-income countries, the risk of female-to-male transmission is estimated as 0.38% per act, and of male-to-female transmission as 0.30% per act; the equivalent estimates for high-income countries are 0.04% per act for female-to-male transmission, and 0.08% per act for male-to-female transmission.	9,181	45	0.65
ART					
Management of HIV/AIDS	Treatment guidelines	A separate argument for starting antiretroviral therapy that has gained more prominence is its effect on HIV transmission. ART reduces the amount of virus in the blood and genital secretions.[41][42] This has been shown to lead to dramatically reduced transmission of HIV when one partner with a suppressed viral load (¡50 copies/ml) has sex with a partner who is HIV negative. In clinical trial HPTN 052, 1763 serodiscordant heterosexual couples in 9 countries were planned to be followed for at least 10 years, with both groups receiving education on preventing HIV transmission and condoms, but only one group getting ART. The study was stopped early for ethical reasons when it became clear that antiviral treatment provided significant protection.	5,895	10	0.09
Misconceptions about HIV/AIDS	Treatment	Highly Active Anti-Retroviral Therapy (HAART) in many cases allows the stabilization of the patient's symptoms, partial recovery of CD4+ T-cell levels, and reduction in viremia (the level of virus in the blood) to low or near-undetectable levels. [...] while HIV-positive people with low viremia are less likely to infect others	3,838	8	0.05
Prevention of HIV/AIDS	Prevention strategies	Early treatment of HIV-infected people with antiretrovirals protected 96% of partners from infection.	3,274	4	0.03
HIV and pregnancy	Diagnosis/screening	When HIV infected partners were on ART there was 96% less transmission of HIV and none from partners with undetectable viral loads.	2,618	2	0.01
Total				**20**	**0.18**
Sugar Daddies					
Epidemiology of HIV/AIDS	(intro)	Across Sub-Saharan Africa, more women are infected with HIV than men, with 13 women infected for every 10 infected men. This gender gap continues to grow. Throughout the region, women are being infected with HIV at earlier ages than men. The differences in infection levels between women and men are most pronounced among young people (aged 15–24 years). In this age group, there are 36 women infected with HIV for every 10 men.	3,897	3	0.23

Notes: This table displays pages that contain information relevant to the *HIV*, *ART*, and *Sugar Daddies* questions, along with the key section and statements from which the answer could be found or inferred in historical versions of the page available during the intervention. These historical versions of pages were reviewed using the Internet Archive "Wayback Machine". The last two columns show how many students in the treatment group looked at each of these pages, and how much time students spent on each page on average across the treatment group during the 8-month period when the digital libraries were open (November 2017 to June 2018).

Appendix Table A5: Certainty about Health Information Answers

	Correct Answer				Incorrect Answer			
	Treatment		Control		Treatment		Control	
	(1) % Certain	(2) N	(3) % Certain	(4) N	(5) % Certain	(6) N	(7) % Certain	(8) N
Panel A: First Endline								
Fertility (female students)	0.936	47	0.923	39	0.771	83	0.815	81
Fertility (male students)	0.963	54	0.980	49	0.909	88	0.884	95
HIV questions (all students)	0.786	14	1.000	10	0.966	558	0.960	554
Panel B: Two to Five Weeks Later								
Fertility (female students)	0.958	48	0.966	59	0.868	76	0.889	54
Fertility (male students)	1.000	41	0.981	54	0.954	108	0.990	102
HIV questions (all students)	0.714	7	0.923	13	0.956	821	0.963	806
Panel C: Long-run Survey								
Fertility (female students)	0.564	39	0.562	48	0.679	78	0.613	62
Fertility (male students)	0.771	48	0.809	47	0.783	92	0.739	92
HIV questions (all students)	0.786	56	0.811	53	0.876	727	0.878	690
Panel D: Long-run Survey - Specific HIV Questions								
ART question	0.833	36	0.867	30	0.880	225	0.867	218
HIV question	0.875	8	0.750	4	0.889	253	0.881	243
Panel E: With Information								
ART* question	0.854	144	0.802	126	0.752	117	0.732	123
HIV question	0.914	35	0.897	29	0.881	226	0.891	220
Panel F: After 15-minute break								
ART* question	0.887	150	0.879	132	0.856	111	0.812	117
HIV question	0.976	41	0.971	34	0.935	216	0.902	215

Notes: This table displays the percentage and number of respondents who are certain about their correct (Columns 1 to 4) and incorrect (Columns 5 to 8) answers by treatment status. Panel A presents the statistics at the first endline and the HIV questions include the *HIV* and *ART* questions on the HIV transmission rate and the role of antiretroviral treatment in preventing HIV transmission. In Panels B and C, two to five weeks and five to seven years after the first endline, respectively, the HIV questions also include the *Sugar Daddies* question about the likelihood of HIV-infection for men by age. The *Fertility* question, displayed by gender, is on the timing of the fertile window for women. Panels D, E and F focus on the ART and HIV questions in the long-run survey. Panels D, E and F are later in the long-run survey, after receiving information about the correct answer (Panel E) and following a 15-minute break (Panel F). See Appendix Table A2 for the complete set of questions and their multiple-choice options. ART* is a modified version of the ART question: "Do you believe that it is impossible for a person with an undetectable viral load to spread HIV?" Certainty is constructed using information on whether the respondent is certain or very certain about their answer.

Appendix Table A6: Wikipedia Access and Long-Run Sexual Health Behaviors by School Type

	Individual Outcomes					Indices	
	(1) Sex before 18	(2) Married before 20	(3) Pregnancy before 20	(4) Unprotected Sex	(5) Tested for HIV	(6) (1) to (4)	(7) HIV Risk
Panel A: Average Treatment Effect							
Treatment	-0.079***	-0.003	-0.016	0.013	-0.030	-0.093**	-0.038
	(0.028)	(0.005)	(0.011)	(0.046)	(0.041)	(0.043)	(0.060)
Panel B: Heterogeneous Treatment Effect							
Treatment × co-educational	-0.091**	0.001	-0.031	-0.063	-0.092	-0.151**	-0.162
	(0.046)	(0.009)	(0.020)	(0.073)	(0.060)	(0.073)	(0.102)
Treatment × sex-seggregated	-0.069*	-0.007	-0.003	0.069	0.021	-0.043	0.067
	(0.035)	(0.006)	(0.012)	(0.059)	(0.058)	(0.050)	(0.070)
Mean control	0.141	0.008	0.025	0.384	0.699	-0.002	-0.004
Mean control - co-ed.	0.157	0.009	0.037	0.500	0.726	0.088	0.227
Mean control - sex-seg.	0.127	0.008	0.015	0.296	0.676	-0.077	-0.195
Observations	497	493	481	458	509	511	499

Notes: This table shows the average and heterogeneous treatment effect of access to Wikipedia on long-run sexual health behaviors, disaggregated by school type. See Table 5 for a description of the outcomes. Panel A shows the average treatment effect and Panel B presents the heterogeneous effects by school type. Two schools were co-educational and two schools were sex-segregated. All regressions include a strata fixed effect and a time trend indicating the month-year of the long-run follow-up survey. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A7: Wikipedia Access and Sensitive Outcomes Controlling for Survey Mode

	Sexual Health Behaviours			Attitudes			
	(1) Sex before 18	(2) Unprotected Sex	(3) Tested for HIV	(4) Same-sex relationships	(5) Transgender	(6) Gender Norms	(7) Sex Before Marriage
Panel A: Average Treatment Effect							
Treatment	-0.079***	0.012	-0.030	0.004	0.115*	0.030	-0.290
	(0.028)	(0.046)	(0.042)	(0.056)	(0.069)	(0.050)	(0.339)
Survey is in-person	0.105	0.090	-0.060	-0.156	-0.457**	0.163	1.459
	(0.118)	(0.180)	(0.149)	(0.212)	(0.195)	(0.204)	(1.163)
Panel B: Heterogeneous Treatment Effect							
Treatment × male	-0.115***	-0.057	-0.054	-0.074	-0.015	-0.047	-0.731
	(0.043)	(0.063)	(0.056)	(0.079)	(0.094)	(0.069)	(0.477)
Treatment × female	-0.040	0.046	-0.017	0.092	0.267**	0.139*	0.361
	(0.034)	(0.067)	(0.064)	(0.082)	(0.104)	(0.078)	(0.477)
Survey is in-person	0.100	0.045	-0.082	-0.168	-0.475**	0.180	1.580
	(0.117)	(0.181)	(0.153)	(0.209)	(0.191)	(0.201)	(1.160)
Mean control	0.141	0.384	0.699	0.000	-0.001	0.000	4.625
Mean control - male	0.198	0.482	0.732	0.073	0.082	0.030	4.935
Mean control - female	0.072	0.280	0.658	-0.092	-0.105	-0.038	4.236
Observations	497	458	509	510	510	510	507

Notes: This table shows the average and heterogeneous treatment effect of access to Wikipedia on sensitive outcomes related to sexual health behaviors and attitudes towards sex, gender diversity, and norms. *Survey is in-person* is an indicator variable for taking an in-person survey (11 observations). The outcome in Column 1 is an indicator variable that equals one if the respondent declared having sex before 18 years old. In Column 2, the outcome is an indicator variable that equals one if the respondent declared having unprotected sex in the past month. In Column 3, the outcome is an indicator variable that equals one if the respondent declared testing for HIV in the past year or ever taken antiretroviral therapy (ARVs or ART). The outcome in Column 4 includes three distinct variables taking a value between 1 (never justified) and 10 (always justified) regarding homosexuality, homosexuality between two adult men, and between two adult women, and two variables ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that homosexual activity should not be criminalized and whether same-sex marriage should be legalized. The outcome in Column 5 includes two distinct variables taking a value between 1 (never justified) and 10 (always justified) regarding the acceptability of a person born male who lives and dresses like a woman, and of a person born female who lives and dresses like a man; and one variable ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that a person born male who lives like a woman should be free to dress as a woman at work without facing discrimination. The outcome in Column 6 includes one variable taking a value between 1 (never justified) and 10 (always justified) regarding abortion, and two variables ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that men make better executives than women (reversed score) and whether a husband should help his wife with household chores. Finally, the outcome in Column 7 takes a value between 1 (never justified) and 10 (always justified) regarding sex before marriage. Panel A shows the average treatment effect and Panel B presents the heterogeneous effects by school type. All regressions include a strata fixed effect. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A8: Examples of Definitions of a Transgender Person

Scores	Examples of Definitions
A. Related to gender identity	
3	An individual whose gender identity differs from sex
3	Yes.a transgender person is someone whose gender identity differs from that typically associated with sex they were assigned at birth.
3	It's when someone is being identified as the opposite gender, for example a Male being identified as a female
B. Related to a change in gender or sex	
2	Transgender is a person who changes their gender
2	It means changing their gender from either male to female or female to male
2	A transgender is when a person changes him/herself into the opposite sex. Let's say a person was born male but changes himself into female
C. Related to a change using surgery or hormones	
1	When a person undergo surgery to change his or sex from male to female or from female to male
1	Being a transgender means you were born a Male and then you do surgery to change your sex
1	To be a transgender it simply means that when let's say a boy having girl hormones or vise versa
D. Related to behavior	
1	A man behave like woman, and a woman behave like a man
1	It means that a person is let's say a male, can be acting like a female
1	A person who was born male but live life as a woman
E. Other examples	
0	A person who is attracted to both genders
0	Those people who have both reproductive system
0	A transgender is a person who practices homosexuality

Notes: Examples of definitions provided by respondents to the question "Do you know what it means for a person to be transgender?" We grouped all definitions in five main categories and gave a score out of three to each category. The score is used to construct the Definition Index in Column 1 of Table 6.

Appendix Table A9: Correlation between Social Isolation and LGBT Acceptance

	Acceptance Index	
	(1) Same-sex relationships	(2) Transgender
Fewer friends	0.030	-0.069
	(0.057)	(0.072)
Observations	510	510

Notes: Correlation between network and acceptance towards gender norms and rights. Outcomes are indices constructed following Anderson (2008). The outcome in Column 1 includes three distinct variables taking a value between 1 (never justified) and 10 (always justified) regarding homosexuality, homosexuality between two adult men, and between two adult women, and two variables ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that homosexual activity should not be criminalized and whether same-sex marriage should be legalized. The outcome in Column 2 includes two distinct variables taking a value between 1 (never justified) and 10 (always justified) regarding the acceptability of a person born male who lives and dresses like a woman, and of a person born female who lives and dresses like a man; and one variable ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that a person born male who lives like a woman should be free to dress as a woman at work without facing discrimination. Fewer friends is a dummy variable that equals one if the respondent had fewer friends than the median student at baseline. The correlation is constructed from a regression that includes a strata fixed effect and a time trend indicating the month-year of the long-run follow-up survey. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A10: Wikipedia Access and Long-Run Health Knowledge, Excluding Time Trend

	Knowledge Questions				Indices	
	(1) Fertility	(2) HIV	(3) ART	(4) Sugar Daddies	(5) Knowledge	(6) Misinformation
	Panel A: Average Treatment Effect					
Treatment	-0.049	0.012	0.022	-0.033	-0.038	0.027
	(0.044)	(0.013)	(0.030)	(0.022)	(0.048)	(0.053)
	Panel B: Heterogeneous Treatment Effect					
Treatment × male	-0.006	0.010	0.045	-0.045	-0.016	0.020
	(0.059)	(0.023)	(0.037)	(0.032)	(0.067)	(0.073)
Treatment × female	-0.103	0.015	-0.006	-0.017	-0.065	0.038
	(0.067)	(0.013)	(0.051)	(0.027)	(0.069)	(0.080)
Mean control	0.382	0.016	0.121	0.076	-0.000	0.001
Mean control - male	0.338	0.029	0.079	0.101	-0.007	0.074
Mean control - female	0.436	0.000	0.174	0.045	0.008	-0.092
Observations	510	509	509	510	510	510

Notes: This table shows the average and heterogeneous treatment effect of access to Wikipedia on long-run knowledge around key sexual health misconceptions, disaggregated by gender, without the time trend. In Columns 1 to 4, the outcome is an indicator variable that equals one if the answer is correct. *Fertility* refers to the question about the timing of a woman's fertility window, *HIV* refers to the question about HIV transmission rates, *ART* refers to the question about the effectiveness of antiretroviral treatment in preventing HIV transmission, and *Sugar Daddies* refers to the question about the likelihood of HIV-infection for men by age. See Appendix Table A2 for the complete set of questions and their multiple-choice options. Outcomes in Columns 5 and 6 are indices constructed following Anderson (2008). Column 5 is a knowledge index constructed using indicator variables on whether the three or four health questions asked are answered correctly. Column 6 is an index constructed from indicator variables that equal one if the answer to the question is incorrect and the respondent is certain about their incorrect answer. Panel A shows the average treatment effect and Panel B presents the heterogeneous effects by gender. All regressions include a strata fixed effect. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A11: Wikipedia Access and Long-Run Sexual Health Behaviors, Excluding Time Trend

	Individual Outcomes					Indices	
	(1) Sex before 18	(2) Married before 20	(3) Pregnancy before 20	(4) Unprotected Sex	(5) Tested for HIV	(6) (1) to (4)	(7) HIV Risk
Panel A: Average Treatment Effect							
Treatment	-0.078***	-0.003	-0.016	0.006	-0.032	-0.095**	-0.058
	(0.028)	(0.005)	(0.011)	(0.046)	(0.041)	(0.043)	(0.061)
Panel B: Heterogeneous Treatment Effect							
Treatment × male	-0.116***	-0.001	-0.025*	-0.056	-0.055	-0.144**	-0.132
	(0.043)	(0.003)	(0.014)	(0.063)	(0.056)	(0.056)	(0.093)
Treatment × female	-0.033	-0.006	-0.005	0.063	0.000	-0.032	0.041
	(0.032)	(0.014)	(0.019)	(0.065)	(0.062)	(0.073)	(0.072)
Mean control	0.141	0.008	0.025	0.384	0.699	-0.002	-0.004
Mean control - male	0.198	0.000	0.023	0.482	0.732	0.058	0.177
Mean control - female	0.072	0.019	0.029	0.280	0.658	-0.078	-0.223
Observations	497	493	481	458	509	511	499

Notes: This table shows the average and heterogeneous treatment effect of access to Wikipedia on long-run sexual health behaviors disaggregated by gender, without the time trend. The outcome in Column 1 is an indicator variable that equals one if the respondent declared having sex before 18 years old. In Columns 2 and 3, the outcomes are respectively indicator variables that equal one if the respondent was (2) married or (3) had a pregnancy (or impregnated someone) before 20 years old. In Column 4, the outcome is an indicator variable that equals one if the respondent declared having unprotected sex in the past month. In Column 5, the outcome is an indicator variable that equals one if the respondent declared testing for HIV in the past year or ever taken antiretroviral therapy (ARVs or ART). Outcomes in Columns 6 and 7 are indices constructed following Anderson (2008). Column 6 is a combination of all the outcomes from Columns 1 to 4. Column 7 is constructed using information on the total number of sexual partners in their life, the number of sexual partners in the past month, and an indicator variable that equals one if they had unprotected sex in the past month. Panel A shows the average treatment effect and Panel B presents the heterogeneous effects by gender. All regressions include a strata fixed effect. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A12: Wikipedia Access and Long-Run Attitudes towards Sex, Gender Diversity, and Norms, Excluding Time Trend

	Definition Index	Acceptance Indices			
	(1)	(2) Same-sex relationships	(3) Transgender	(4) Gender Norms	(5) Sex Before Marriage
Panel A: Average Treatment Effect					
Treatment	-0.037	-0.007	0.109	0.028	-0.358
	(0.066)	(0.056)	(0.070)	(0.050)	(0.340)
Panel B: Heterogeneous Treatment Effect					
Treatment × male	-0.002	-0.074	-0.017	-0.044	-0.702
	(0.095)	(0.079)	(0.094)	(0.069)	(0.480)
Treatment × female	-0.081	0.081	0.270***	0.117	0.074
	(0.096)	(0.080)	(0.103)	(0.077)	(0.483)
Mean control	-0.001	0.000	-0.001	0.000	4.625
Mean control - male	-0.021	0.073	0.082	0.030	4.935
Mean control - female	0.024	-0.092	-0.105	-0.038	4.236
Observations	510	510	510	510	507

Notes: This table shows the average and heterogeneous treatment effect of access to Wikipedia on long-run attitudes towards sexuality and gender, disaggregated by gender, without the time trend. Outcomes in Columns 1 to 4 are indices constructed following Anderson (2008). The outcome in Column 1 uses categorical variables on whether the respondent can correctly define LGBT and transgender. See Appendix Table A8 for examples of definitions provided by the respondents. The outcome in Column 2 includes three distinct variables taking a value between 1 (never justified) and 10 (always justified) regarding homosexuality, homosexuality between two adult men, and between two adult women, and two variables ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that homosexual activity should not be criminalized and whether same-sex marriage should be legalized. The outcome in Column 3 includes two distinct variables taking a value between 1 (never justified) and 10 (always justified) regarding the acceptability of a person born male who lives and dresses like a woman, and of a person born female who lives and dresses like a man; and one variable ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that a person born male who lives like a woman should be free to dress as a woman at work without facing discrimination. The outcome in Column 4 includes one variable taking a value between 1 (never justified) and 10 (always justified) regarding abortion, and two variables ranging between 1 (strongly disagree) and 5 (strongly agree) on whether they agree that men make better executives than women (reversed score) and whether a husband should help his wife with household chores. See Appendix Figure A8 for the distribution of these measures in the full sample. Finally, the outcome in Column 5 takes a value between 1 (never justified) and 10 (always justified) regarding sex before marriage. All regressions include a strata fixed effect. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A13: Wikipedia Access and Long-Run Internet Use, Excluding Time Trend

	Panel A: Access to a Smartphone		
	(1) Had Phone Before 20	(2) Minutes on Phone	(3) *Has Digital Wellbeing*
Treatment	0.042	4.293	-0.004
	(0.040)	(21.585)	(0.044)
Treatment × male	0.024	-13.771	-0.086
	(0.057)	(34.162)	(0.058)
Treatment × female	0.060	20.413	0.097
	(0.055)	(26.524)	(0.069)
Mean control	0.604	271.761	0.440
Mean control - male	0.518	257.630	0.424
Mean control - female	0.712	289.246	0.459
Observations	511	270	511
	Panel B: Internet Use		
	Days on Internet	Internet Bundles	*Free Internet*
Treatment	-0.063	-1161.289*	0.060
	(0.206)	(692.996)	(0.042)
Treatment × male	-0.319	-794.657	0.008
	(0.301)	(1014.002)	(0.057)
Treatment × female	0.245	-1653.848*	0.125*
	(0.264)	(939.253)	(0.065)
Mean control	5.560	7020.014	0.402
Mean control - male	5.439	7130.219	0.403
Mean control - female	5.712	6868.333	0.400
Observations	510	442	509
	Panel C: Wikipedia Use		
	Used Wikipedia	Wikipedia Pages	*Has Browsing History*
Treatment	0.083***	0.089	-0.016
	(0.027)	(0.814)	(0.041)
Treatment × male	0.061*	0.949	-0.031
	(0.034)	(0.673)	(0.058)
Treatment × female	0.113***	-0.541	-0.003
	(0.042)	(1.319)	(0.054)
Mean control	0.855	5.130	0.644
Mean control - male	0.885	2.486	0.518
Mean control - female	0.818	7.270	0.802
Observations	510	325	511
	Panel D: Social Media, Wikipedia, and Health		
	Social Media Usage	Social Media and Health	Wikipedia and Health
Treatment	0.003	-0.053	0.076
	(0.036)	(0.052)	(0.066)
Treatment × male	-0.033	-0.032	0.115
	(0.047)	(0.068)	(0.090)
Treatment × female	0.050	-0.081	0.018
	(0.057)	(0.081)	(0.096)
Mean control	0.021	-0.000	-0.001
Mean control - male	-0.007	-0.035	-0.132
Mean control - female	0.057	0.043	0.165
Observations	510	510	510

Notes: This table shows the average and heterogeneous treatment effect of access to Wikipedia on long-run internet use, disaggregated by gender, without the time trend. Panel A. Access to smartphone: (1) Owned phone before 20 years old; (2) Minutes on smartphone last Wednesday/Saturday; (3) Has Digital Wellbeing Panel B. Internet usage: (1) Days they used the internet over the past week; (2) Amount spent in Malawian Kwacha on internet bundles; (3) Accessed internet for free in the past month. Panel C. Wikipedia usage: (1) Ever used Wikipedia; (2) Number of Wikipedia pages they looked at in the past week; (3) Have browsing history. Panel D. Social media usage and online information on health. All indices are constructed following Anderson (2008): (1) Amount spent on social media bundles, minutes using social media last Wednesday/Saturday, how often they used social media in the past month, and have social media accounts (Facebook, Twitter, Tiktok, and WhatsApp); (2) Use social media for information about health and social media in top 3 best place to find information about health; (3) Use Wikipedia for information about health and Wikipedia in top 3 best place to find information about health. Outcomes in Column 3 from Panels A, B, and C were not pre-specified in the analysis plan. All regressions include a strata fixed effect and a time trend indicating the month-year of the long-run follow-up survey. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A14: Is Wikipedia Information Better than the Internet?

	How is Wikipedia better		
	(1) Trustworthy	(2) Easy to understand	(3) Easy to find
Treatment	0.262***	0.333***	0.247***
	(0.039)	(0.038)	(0.038)
Mean control	0.436	0.495	0.542
Observations	549	549	549

Notes: From Derksen et al. (2022). The outcomes are indicators calculated based on answers to the question "How is Wikipedia better than other sites on the internet?". (1) is equal to one if option "Information on Wikipedia is more trustworthy" was chosen. (2) if "It is easier to understand information on Wikipedia" was chosen. (3) if "It is easier to find information on Wikipedia" was chosen. Other alternatives were "There is more information on Wikipedia", "There are more things to do on Wikipedia", and "Don't know". The sample is students in the treatment group and in the subsample of the control group with supplementary surveys. All regressions include strata fixed effects. Randomization was stratified by school, form, above median achievement and past internet use. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

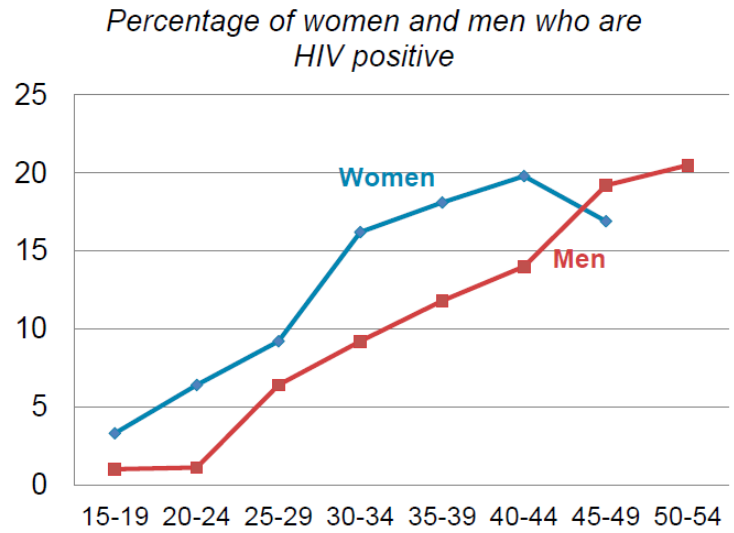
Appendix Table A15: Wikipedia Access and Exam Scores

	Final Exam Scores		
	(1) Life Skills	(2) Social Studies	(3) Index
	Panel A: Average Treatment Effect		
Treatment	-0.069	0.003	-0.048
	(0.071)	(0.083)	(0.059)
	Panel B: Heterogeneous Treatment Effect		
Treatment × male	-0.004	0.037	-0.005
	(0.110)	(0.152)	(0.094)
Treatment × female	-0.120	-0.027	-0.095
	(0.094)	(0.100)	(0.075)
Mean control	0.000	0.000	0.006
Mean control - male	-0.022	-0.009	-0.018
Mean control - female	0.018	0.006	0.029
Observations	901	651	1078

Notes: This table shows the average and heterogeneous treatment effect of access to Wikipedia on exam scores in Life Skills and Social Studies. The sample is all students who took the Life Skills (Column 1) or Social Studies (Column 2) final examination. In Column 3, we construct an index following Anderson (2008) using the exam scores on the two subjects. See Appendix F for examples of examination questions. Panel A shows the average treatment effect and Panel B presents the heterogeneous effects by gender. All regressions include a strata fixed effect. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

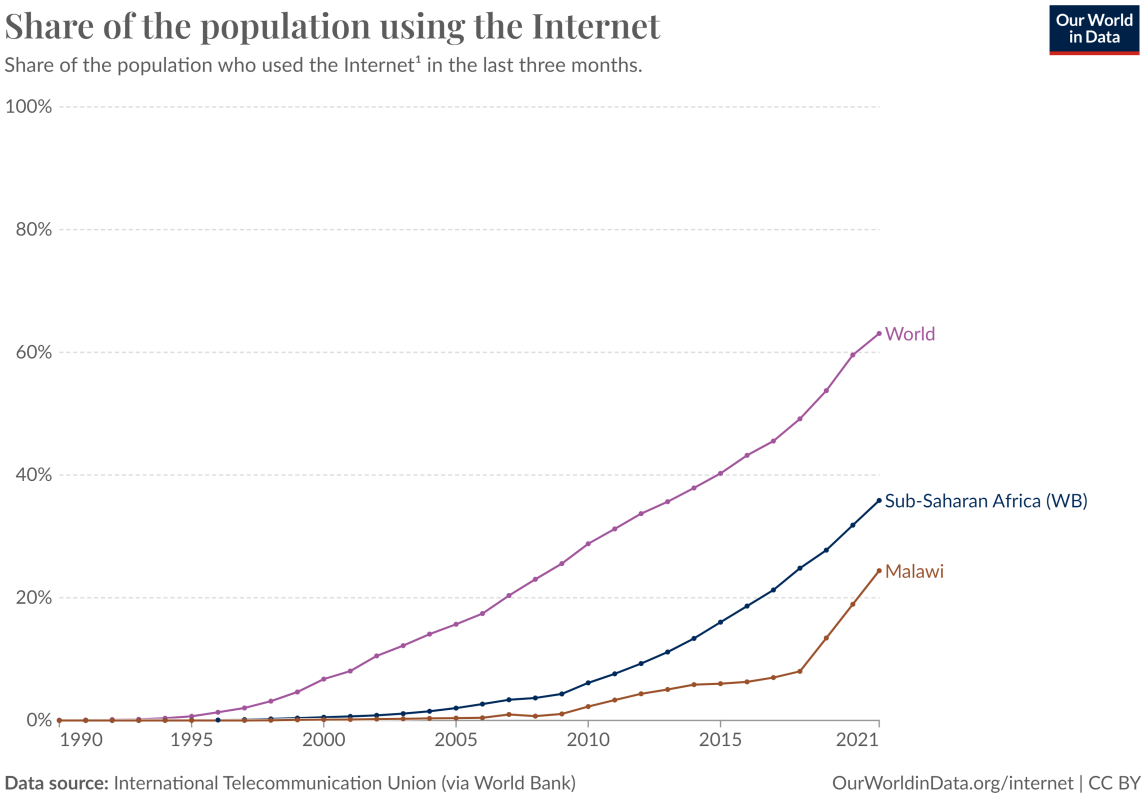
Appendix Figures

Appendix Figure A1: HIV Prevalence by Age in Malawi



Notes: Figure reproduced from Malawi DHS 2015-16 Final Report (DHS, 2016).

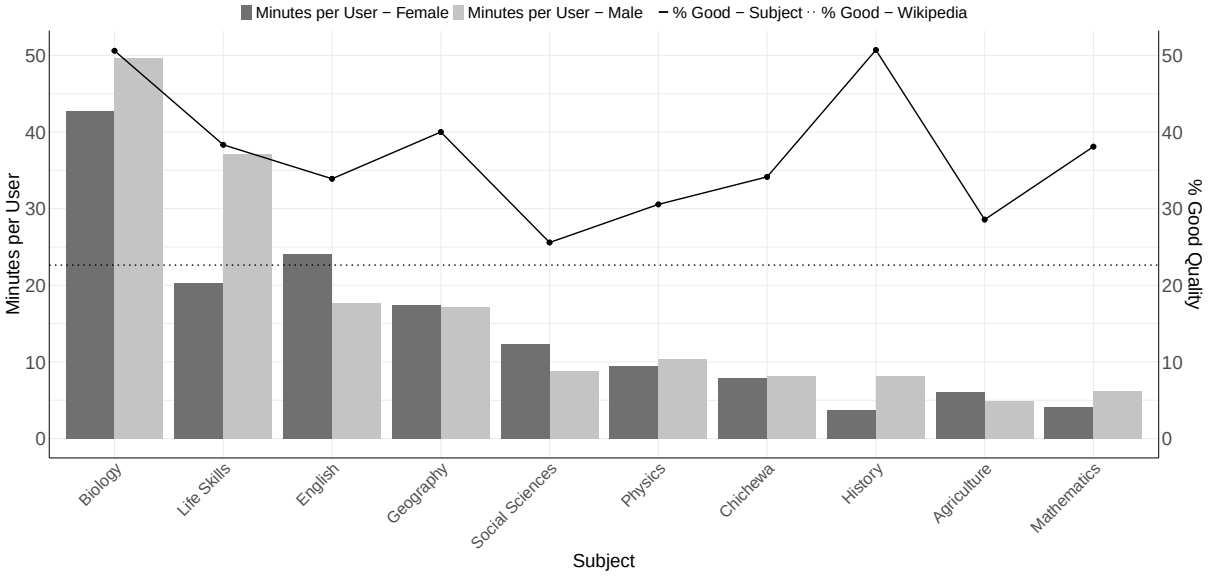
Appendix Figure A2: Share of Individuals Using the Internet



1. Internet user: An internet user is defined by the International Telecommunication Union as anyone who has accessed the internet from any location in the last three months. This can be from any type of device, including a computer, mobile phone, personal digital assistant, games machine, digital TV, and other technological devices.

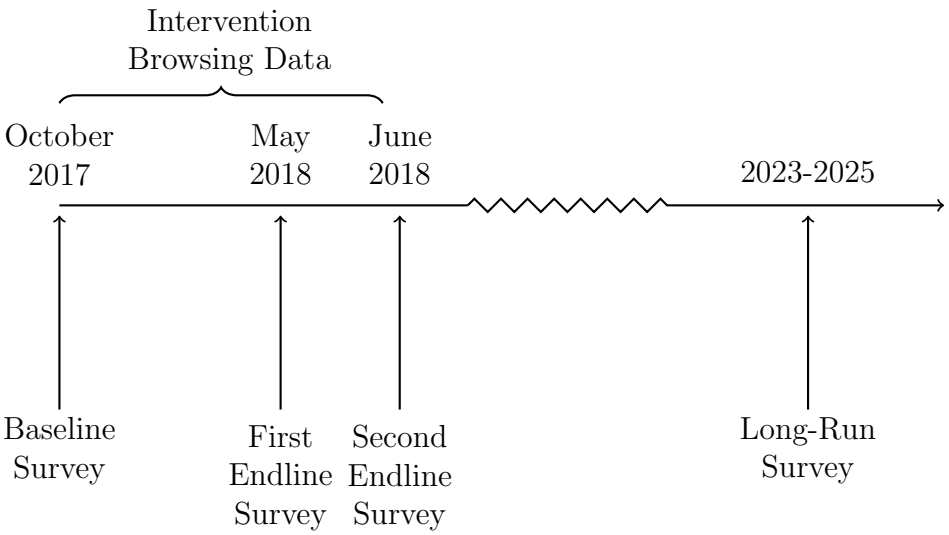
Notes: Figure reproduced from https://ourworldindata.org/internet (Ritchie et al., 2023), accessed on 16 October, 2024.

Appendix Figure A3: Browsing Time and Quality on Syllabus-Related Pages



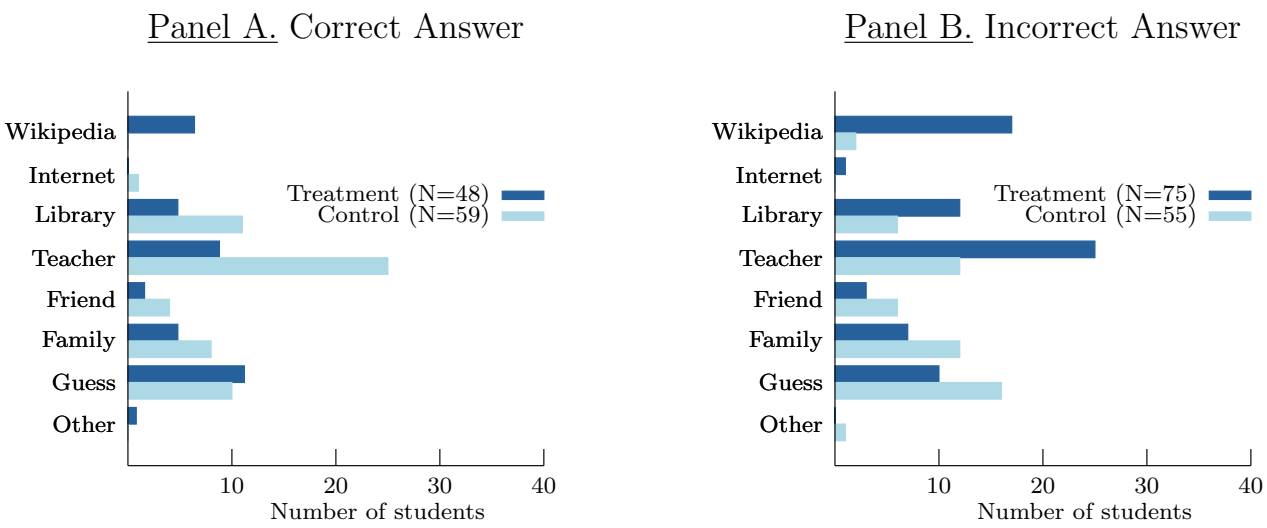
Notes: This figure describes the total amount of time students spend on pages related to the school syllabus by gender across all treated students. The solid black line describes the average quality of pages in each respective subject. The black horizontal dash line corresponds with the average page quality of all pages that students searched during the experiment.

Appendix Figure A4: Data Collection Timeline



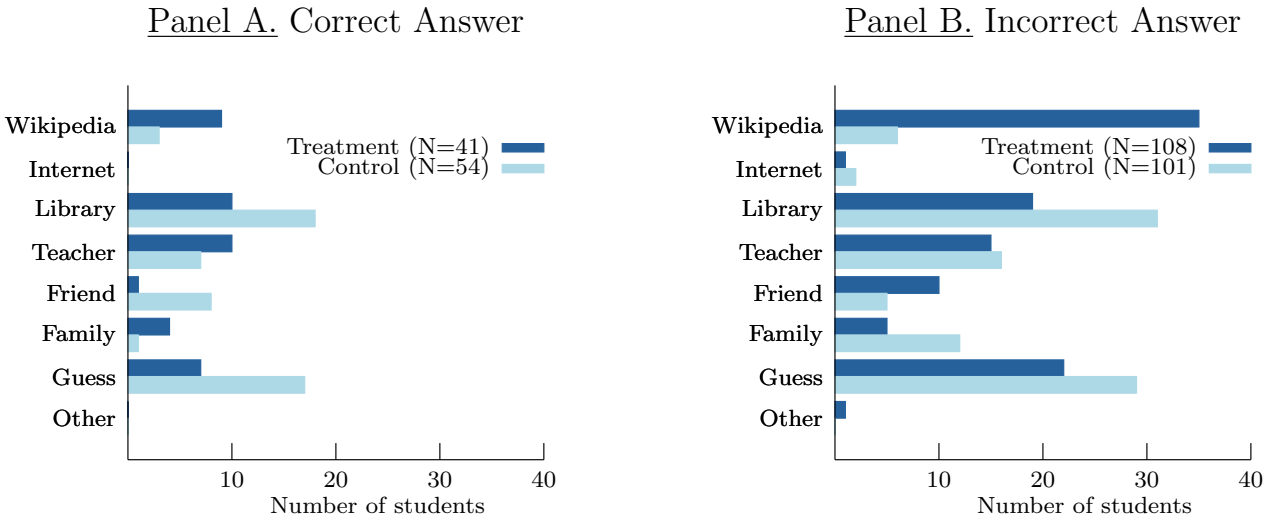
Notes: Timeline of data collection for baseline, endline, and long-term surveys. The intervention began in November 2017 and ended in June 2018, and browsing data is available for this period. The long-term surveys began in July 2023 and ended in March 2025.

Appendix Figure A5: Source of Information: Female Students on the Fertility Question



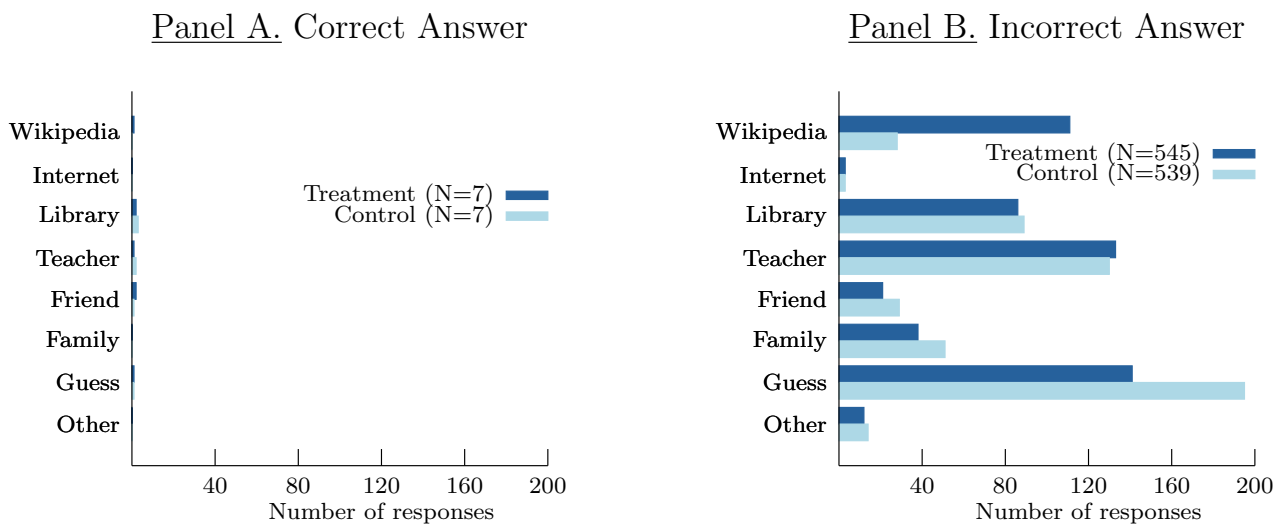
Notes: This figure shows the source of information to the correct (Panel A) and incorrect (Panel B) answers to the *Fertility* question on the timing of the fertile window for women by treatment status. See Appendix Table A2 for the complete question and its multiple-choice options. The sample only includes female students. Data is collected at the second endline.

Appendix Figure A6: Source of Information: Male Students on the Fertility Question



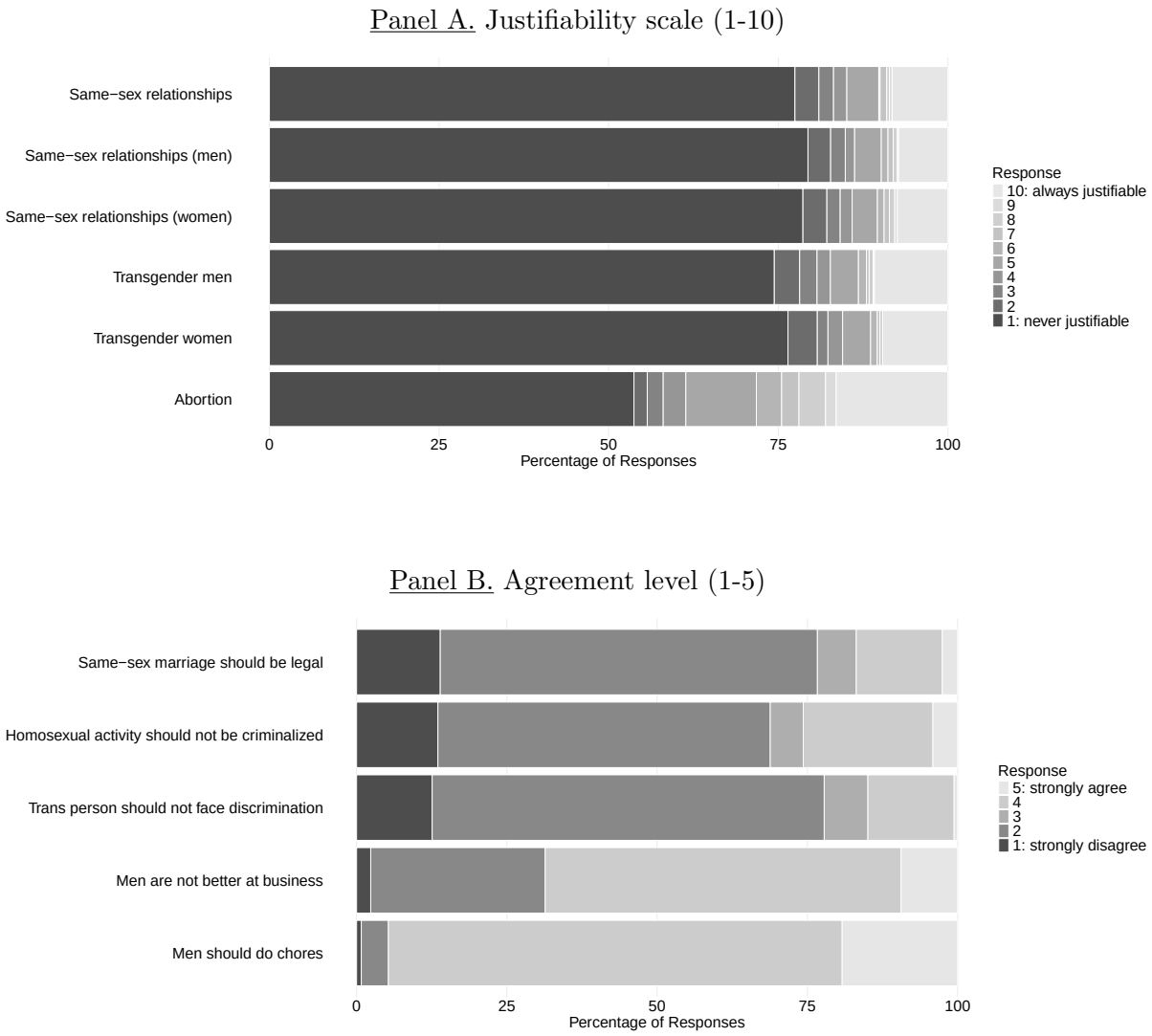
Notes: This figure shows the source of information to the correct (Panel A) and incorrect (Panel B) answers to the *Fertility* question on the timing of the fertile window for women by treatment status. See Appendix Table A2 for the complete question and its multiple-choice options. The sample only includes male students. Data is collected at the second endline.

Appendix Figure A7: Source of Information: All Students on the HIV Questions



Notes: This figure shows the source of information to the correct (Panel A) and incorrect (Panel B) answers to the *HIV*, *ART*, and *Sugar Daddies* questions by treatment status. *HIV* refers to the question about HIV transmission rates, *ART* refers to the question about the effectiveness of antiretroviral treatment in preventing HIV transmission, and *Sugar Daddies* refers to the question about the likelihood of HIV-infection for men by age. See Appendix Table A2 for the complete set of questions and their multiple-choice options. Data is collected at the second endline.

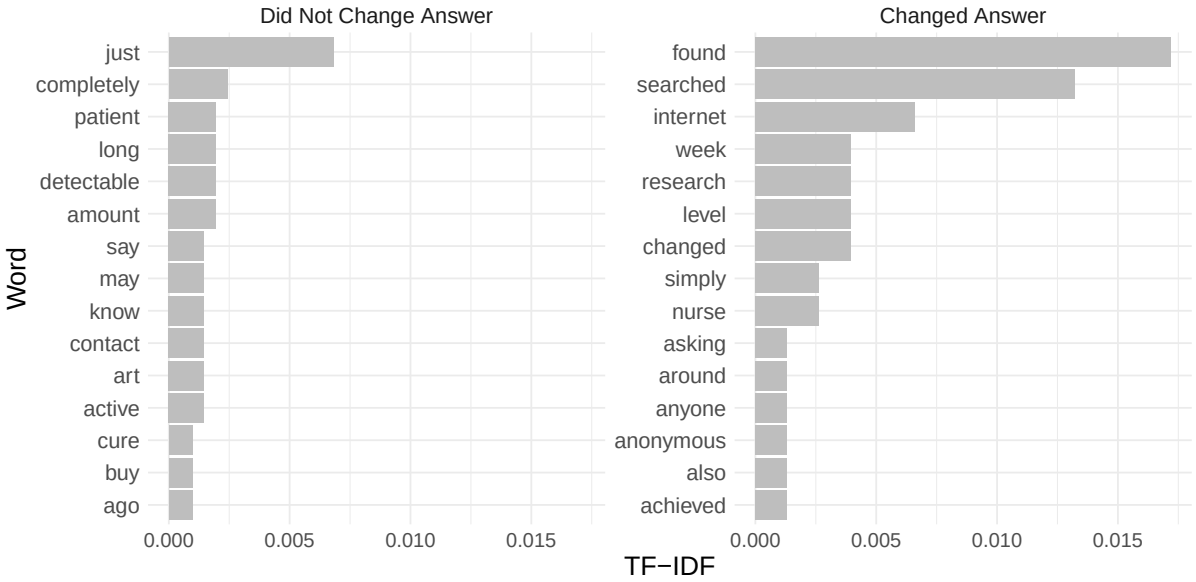
Appendix Figure A8: Attitudes towards Gender Norms and Rights



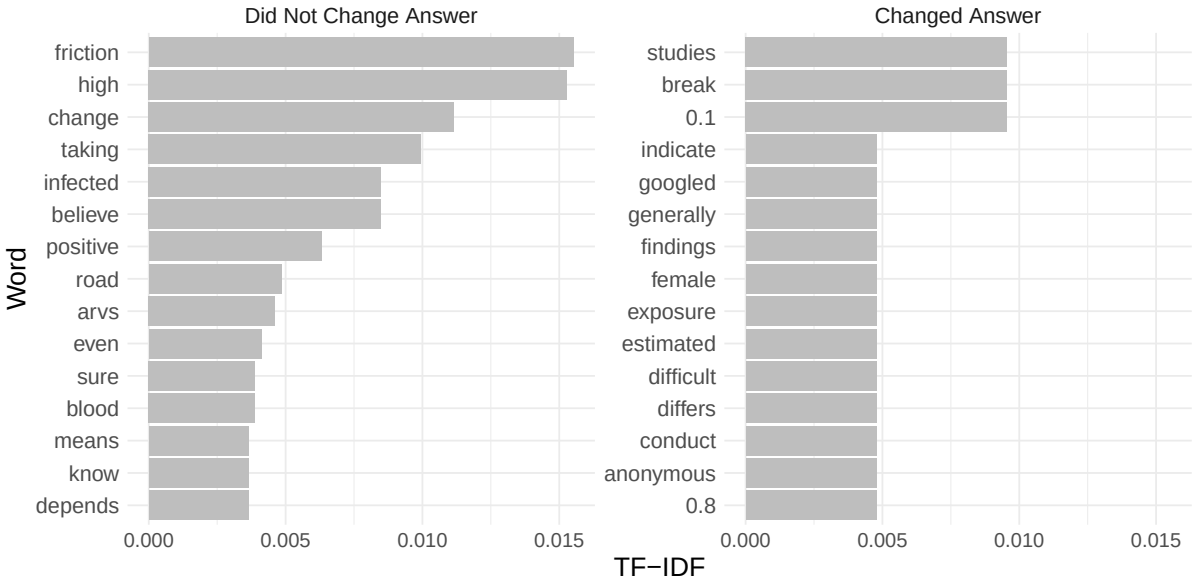
Notes: This figure describes the proportion of people reporting attitudes towards gender and sexuality-related norms and rights. Panel A includes six questions about how justifiable concepts were on a scale of 1 (never justifiable) to 10 (always justifiable). They were asked whether same-sex relationships (in general), same-sex relationships (male or female), transgender men, transgender women, and abortion were ever justifiable. The darkest bars indicate the proportion of people who responded that an activity was never justifiable, the lightest bar indicates the proportion who responded that an activity was always justifiable. Panel B included five questions about how strongly they agree with different statements. They were asked how strongly they agreed with the idea that same-sex marriage should be legal, homosexual activity should not be criminalized, trans people should not face discrimination, men are not better at business, and men should do chores. The darkest bars indicate the proportion who strongly disagreed, the lightest bars indicate the proportion who strongly agreed. The direction of the questions "homosexual activity should not be criminalized" and "men are not better at business" have been reversed to keep the interpretation consistent with other questions. The questions "men are not better at business" and "men should do chores" did not include a neutral option.

Appendix Figure A9: Descriptions of Answer Changes

Panel A. TF-IDF for Explanations of Response Changes - ART Question

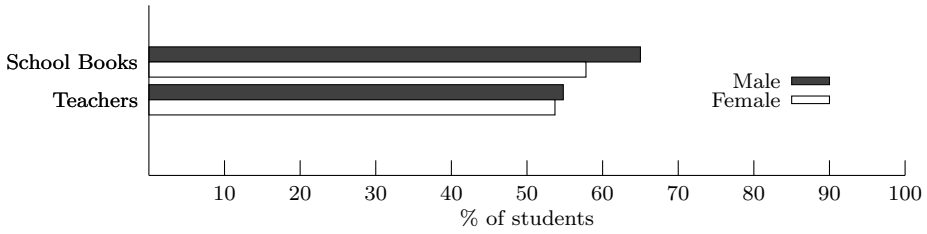


Panel B. TF-IDF for Explanations of Response Changes - HIV Question



Notes: This figure describes the relative frequency of terms used in response to the question "Did you change your answer to this question? Why or why not?" after answering the ART Question (Panel A) or the HIV Question (Panel B) incorrectly before a 15-minute break in the long-run survey. These questions are described in Figure 6. The relative frequency of terms used in these responses is measured by each word's "term frequency-inverse document frequency" (TF-IDF). Higher TF-IDF values indicate a term is relatively more important within that subset of responses. The figures on the left side of each panel show the most important words for participants who did not change their incorrect response after a short break, the right side of each panel shows the most important words for participants who changed their response to the correct answer after a short break.

Appendix Figure A10: Student Preference for Wikipedia for Information about Safe Sex



Notes: Percent of male and female treated students who prefer Wikipedia over school books and teachers, respectively, for information about safe sex. Data is collected at the second endline. Students are asked to rank sources according to the "best place to find information about safe sex".

B Classroom Introduction to the Project

This Appendix is reproduced from Derksen et al. (2022).

- We are working for the University of Toronto in Canada for a research project
- The research project will take place in this school for the entire school year in which some students in Forms 2-4 will have access to a digital library with phones with access to an online encyclopedia.
- First, we would like to survey every student in Forms 2-4.
- The survey is not too long – about 10-20 minutes
- After the survey is finished, we are going to select some students for the mobile phone program
- The students are going to be selected RANDOMLY – it is not the best students. Every student in Forms 2-4 has the chance to be selected. [Make sure this is extremely clear]
- We cannot select every student, only a few students will be selected
- During the year, those selected students will be able to take part in a digital library program
- A digital library will be set up in [classroom]
- There will be a number of mobile phones with access to an online encyclopedia
- Students taking part in the program will be able to search online for information about their studies and other information [see examples below]
- If you are not selected for the program, you are free to ask selected students to search for something or to explain what they have learned
- If you are selected, you are free to take part or to refuse, you are not obligated to use the digital library
- We will continue to ask some students to answer short surveys throughout the year – these will include some selected students and other students
- Any questions?
- Looking forward to seeing you again when we will be conducting the survey

About Wikipedia

A lot of information can be accessed on Wikipedia. This includes information about academics, health, politics, world news, sports and entertainment.

For example, suppose your Biology teacher says that next week you will start the topic of photosynthesis. If you search Wikipedia, you will find a detailed explanation of the process of photosynthesis, with equations and illustrations.

I will give you another example. Suppose you did not understand the different types of soil you discussed in agriculture class. You can use Wikipedia to find out more about the topic, including the definition of soil and the various types of soil. Wikipedia includes information about soil fertility, soil formation and the different functions of the soil.

In Wikipedia, you can find information about almost any topic from your studies. For example, you can find information about chemical reactions and the periodic table in chemistry, matter in physics and volcanos in geography. You can even review different rules you learn in Mathematics such as the rules for exponents. You can find information about local and international authors.

If you are thinking about what you want to do after secondary school, you can search Universities in Malawi and you will find a list of all colleges, public and private universities in Malawi. You can even look into the careers you may be interested in pursuing.

As we said, there is information just about everything on Wikipedia. If you want to know more about menstruation, birth control or pregnancy, you will find it in Wikipedia. Wikipedia talks also about different diseases such as malaria, Ebola and HIV. You can find information about the causes, symptoms and prevention.

You can find information about local politics and international news. You can find information about sports stars like Lionel Messi, and celebrities like Jay-Z or Nicki Minaj.

We think this project will help you a lot with your studies. Even if you are not selected for the program, you can ask your friends to search for information on a topic from class. If you are selected, you can share what you learn with your classmates.

C Digital Library Induction

This section is reproduced from Derksen et al. (2022).

Instructions for Digital Librarians

- The induction should be done in small groups – enough so that each student can use one phone. Only for selected students
- Explain the digital library itself; Opening hours
- Explain Wikipedia. What it is, what kind of information you can find
- Explain privacy. Anonymous, you are free to search anything.[32]

[32][Note added: The instructions for the digital librarians did not explicitly state that they should inform students that anonymous browsing histories would be collected for research purposes.]

- You can only use Wikipedia. Everything else is blocked
- Practice together. Give several examples of things to search for (e.g. photosynthesis and Malawi).
- Show how to solve common problems. How to get back to search page (home three dots OR icon). Show what happens if they try to click on external links or restart the phone

How to Use the Digital Library

- There are 12 phones in the digital library
- Sign in with the librarian
- If all phones are in use, join the waiting list or come back later
- If there is a waiting list, students are restricted to 30 minutes (35-40 minutes when the network is not good)
- Use the phone within the library
- Do not try to tamper with the phones
- There are no backup phones so if one breaks or goes missing there will be fewer phones to use
- Privacy. Your searches are anonymous – no one can see what you personally searched for (not the researchers, not the field team, not the teachers). This is a very important point – make sure the students can explain it back.

Digital Library Rules

1. Only selected students can use the digital library
2. When you arrive, sign in with the digital librarian.
3. The phones should be used one by one (not in pairs)
4. Take care not to damage or tamper with the phone
5. Do not try to access other websites than Wikipedia
6. When you are done, return the phone to the digital librarian
7. Do not hand the phone to any other student

If you break the rules you will be suspended or removed from the program

D Analysis Plan

This Appendix is a reproduction of our Analysis Plan (AP) available at https://www.socialscienceregistry.org/trials/3824. The last column describes, if applicable, any deviations from the AP, including rationale and timing.

RQ1. Does access to high quality online information impact long-run knowledge around key sexual health misconceptions (fertility and HIV transmission)?

RQ1a. Short-run quiz questions - First Endline
(Columns 1–3 of Table 2 and Column 1 of Table 3)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
V1a.1 (I_1a)	Imagine a woman who has a menstrual cycle every month. She will be fertile on certain days every month. This is called the fertile window. That means if she has sex on those days, she might get pregnant. How many fertile days does an average woman have every cycle?	(a) 1-4 days (b) 5-7 days (c) 7-12 days (d) more than 12 days (e) Don't know (f) Refuse to answer	= 1 if (b); 0 otherwise. Missing if refused.	No.[1]
V1a.2 (I_1a)	I want to ask you about the HIV transmission rate. Imagine an HIV-positive man who is NOT on treatment (ARVs) has unprotected sex with an HIV-negative woman one time. What is the approximate chance that she gets HIV?	(a) 100% chance – she will definitely get HIV (b) 50% chance – she has a 50/50 chance of getting HIV (c) 10% chance – in a single time she will probably not get HIV (d) Less than 1% chance – in a single time she will probably not get HIV (e) Don't know (f) Refuse to answer	= 1 if (d); 0 otherwise. Missing if refused.	No.[1]
V1a.3 (I_1a)	Do you think ARVs can stop a person living with HIV from spreading the virus?	(a) No (b) Yes, ARVs can reduce the chance of spreading the virus but most of the time the virus will still spread (c) Yes, as soon as a person starts taking ARVs they cannot spread the virus at all (d) Yes, a person who has been taking ARVs properly for a long time will almost never spread the virus (e) Don't know (f) Refuse to answer	= 1 if (d); 0 otherwise. Missing if refused.	No.[1]

[1] All three outcomes from RQ1a fall under the secondary outcome category 'general knowledge' in the original registry. They were analyzed before this AP was written. While these outcomes were not pre-specified in detail, we include the complete set of sexual-health knowledge questions collected in the short-run surveys. See Appendix E for more details.

RQ1b. Short-run quiz questions - Second Endline
(Columns 4–7 of Table 2 and Column 3 of Table 3)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
V1b.4 (I_1b)	Who is the most likely to be HIV-positive?	(a) A teenage boy aged 15-19 (b) A man aged 20-24 (c) A man aged 25-29 (d) They all have the same likelihood (e) Don't know (f) Refuse to answer	= 1 if (c); 0 otherwise. Missing if refused.	No, but the survey question and its answers were not copied properly in the AP.[1]
V1b.1 to V1b.3 (I_1b)	Same three questions V1a.1 to V1a.3 as above.			No.[1]

[1]All four outcomes from RQ1b fall under the secondary outcome category 'general knowledge' in the original registry. They were analyzed before this AP was written. While these outcomes were not prespecified in detail, we include the complete set of sexual-health knowledge questions collected in the short-run surveys. See Appendix E for more details.

All long-run outcomes below were analyzed after this Analysis Plan was written and published on AEA Registry.

RQ1c. Long-run quiz questions
(Columns 1–5 of Table 4)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
V1c.1 to V1c.4 (I_2)	Same four questions V1b.1 to V1b.4 as above.			No.

RQ1d. Misinformation index – are students wrong and certain?
(Columns 2 and 4 of Table 3 and Column 6 of Table 4.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
V1.5	a. For each outcome V1.1 to V1.4: On a scale of 1-5, where 1 is not certain at all, and 5 is very certain, how certain are you of your answer?	1=Not certain at all 2=Not very certain 3=Neutral 4=Certain 5=Very Certain	=1 if wrong and certain (=4 or 5)	No.
V1.1 to V1.4	b. Same four questions as above.			

RQ2. Does access to high quality online information impact age of sex, marriage and pregnancy? (Table 5).

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
V2.1 (I_4)	a. Have you ever had sexual intercourse? b. At what age did you have sexual intercourse for the first time?	a. Yes, No, Prefer not to say (pns), Don't know(dk). b. Age between 0 and current age.	=1 if first sex at age <18; 0 if older or never had sex. Missing if pns or dk.	No.
V2.2 (I_4)	a. Are you currently married? b. Have you had any previous marriages? c. Year(s) of marriage. d. How old are you?	a. Yes, No, pns. b. Yes, No, pns. c. Number d. Number	=1 if first married before age 20; = 0 if older or not married.	No.
V2.3 (I_4)	a. Have you ever been pregnant? (female) b. Have you ever impregnated someone? (male) c. How old were you when the first pregnancy took place?	a. b. Yes, No, Prefer not to say, Don't know. c. Age	=1 if first child at age<20; = 0 if older or no children. Missing if pns or dk.	No.
V2.4 (I_4)	a. These days, what contraception do you use? Select all that apply. b. In the past month, how often have you been using contraception?	a. Pull-out method, Monthly timing, Condom, Pills, Injectable, Vaginal ring, implant. b. 1. Never; 2. Rarely; 3. Sometimes; 4. Most of the time; 5. Always.	= 1 if unprotected sex (contraception) in past month.	No.

RQ3. Does access to high quality online information impact HIV risk taking? (Column 7 of Table 5).

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
U3.1 (I_5, index only)	How many sexual partners have you had in your life?	Number	= Number and 0 if never had sex (V2.1a)	No.
U3.2 (I_5, index only)	How many sexual partners have you had in the past month?	Number	= 1 if Number >1	No.
U3.3 (I_5, index only)	In the past month, how often have you been using a method to prevent HIV infection?	1. Never; 2. Rarely; 3. Sometimes; 4. Most of the time; 5. Always.	= 1 if unprotected sex (HIV) in past month	No.
V3.4	For each sexual partner (past month). How old is this sexual partner?	Age	Average age of partners.	Yes. Most respondents reported not knowing or remembering this information. We exclude this outcome because the sample size is insufficient (i.e., N=3).

RQ4. Does access to high quality online information impact demand for HIV-related health care services? (Column 5 of Table 5.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
V4.1	Have you been tested for HIV in the past year? In the past year have you ever taken antiretroviral therapy (ARVs or ART)?	Yes, No, Prefer Not to Say, Don't know.	=1 if tested for HIV and/or on ART past year. Missing if pns or dk.	No.

RQ5. Does access to high quality online information impact knowledge about sexual and gender diversity? (Column 1 of Table 6.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
U5.1 (I_6)	Do you know what LGBT stands for?	After recording their definition of LGBT, we informed them that "LGBT stands for lesbian, gay, bisexual, or transgender".	=1 if correct acronym; 0 = otherwise	No, but we did not record their definition. The enumerator directly recorded if the answer was correct or not.
U5.2 (I_6)	Do you know what it means for a person to be transgender?	After recording their definition of transgender, we informed them that "A transgender person is a person whose gender does not match their sex at birth. For example, a person who was born male but identifies as a woman, or a person who was born female but identifies as a man."	=1 if correct definition; 0 = otherwise	Yes. Given the range of definitions provided, we adopted a categorisation of correct answers as shown in Appendix Table A8.

RQ6. Does access to high quality online information impact attitudes toward sexual and reproductive rights, and gender norms?

RQ6a. Does access to high quality online information impact acceptance of homosexuality index? (Column 2 of Table 6 and Appendix Figure A8.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
	Please tell me for each of the following actions whether you think it can always be justified, never be justified, or something in between.	We will use a scale from 1-10 where 1 is never justifiable and 10 is always justifiable		
U6.1a (I_7)	Homosexuality	1-10	=score	No.
U6.1b (I_7)	Homosexuality between two adult men (gay men)	1-10	=score	No.
U6.1c (I_7)	Homosexuality between two adult women (lesbians)	1-10	=score	No.
U6.2 (I_7)	Do you agree with this statement: all homosexual activity should be criminalized and punished by law.	1=Strongly disagree 2=Disagree 3=Neither agree or disagree 4=Agree 5=Strongly agree	= reversed score	No.
U6.3 (I_7)	Do you agree with this statement: same-sex marriage should be legalized in Malawi.	1=Strongly disagree 2=Disagree 3=Neither agree or disagree 4=Agree 5=Strongly agree	= score	No.

RQ6b. Does access to high quality online information impact acceptance of transgender index? (Column 3 of Table 6 and Appendix Figure A8.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
	Please tell me for each of the following actions whether you think it can always be justified, never be justified, or something in between.	We will use a scale from 1-10 where 1 is never justifiable and 10 is always justifiable		
U6.4a (I_8)	For a person who was born male to live and dress like a woman.	1-10	=score	No.
U6.4b (I_8)	For a person who was born female to live and dress like a man.	1-10	=score	No.
U6.5 (I_8)	Do you agree with this statement: a person who was born male but lives life as a woman should be free to dress as a woman at work without facing discrimination.	1=Strongly disagree 2=Disagree 3=Neither agree or disagree 4=Agree 5=Strongly agree	= score	No.

RQ6c. Does access to high quality online information impact feminism index? (Column 4 of Table 6 and Appendix Figure A8.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
	Please tell me for each of the following actions whether you think it can always be justified, never be justified, or something in between.	We will use a scale from 1-10 where 1 is never justifiable and 10 is always justifiable		
U6.6 (I_9)	Abortion	1-10	=score	No.
U6.7 (I_9)	Do you agree with the following statement? On the whole, men make better business executives than women do.	1=Strongly disagree 2=Disagree 3=Agree 4=Strongly agree	= reversed score	No.
U6.8 (I_9)	Do you agree with the following statement? A husband should help his wife with household chores such as cooking and cleaning.	1=Strongly disagree 2=Disagree 3=Agree 4=Strongly agree	= score	No.

RQ6d. Does access to high quality online information impact justifiability for sex before marriage? (Column 5 of Table 6 and Appendix Figure A8.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
	Please tell me for each of the following actions whether you think it can always be justified, never be justified, or something in between.	We will use a scale from 1-10 where 1 is never justifiable and 10 is always justifiable		
V6.9	Sex before marriage	1-10	= score	No.

RQ7. Does access to high quality online information impact internet use patterns? (Panels A and B of Appendix Table 7.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
V7.1	At what age did you get your first smart phone?	Age	=1 if smart phone before age 20	No.
V7.2	Last [Wednesday/ Saturday], how many hours and minutes do you think you were personally using the phone?	Time (in minutes)	= total minutes using phone on Wed. and Saturday	Yes. For ease of interpretation, we use average time instead of total time. Further, for each day, we use total time spend on all apps that were in use for more than 10 minutes. We made this change after looking at the data because for some respondents, there were large inconsistencies for total time on the phone for this specific variable only. This was due to how data entry was set up in the survey and time zone differences when importing the data.
V7.2b	Has data from Digital Wellbeing to construct V7.2?	Yes or No.	= 1 if V7.2 is non-missing; 0 if missing.	Yes. This outcome was not pre-specified. We added V7.2b after publishing the AP and analyzing the data because we had several missing values for the variable V7.2.
V7.3	Did you pay for full internet use in any other ways over the past month? Enter the full amount in MK.	Amount (in MK)	=amount of money spent on full internet access in past month	Minor. This outcome is the sum of the amount for internet bundles *and* any other amount spend for using internet. The two distinct variables measure overall amount spent on internet access.
V7.3b	Were you able to use the internet for free during the past month? How often?	4=Almost every day; 3=At least once per week; 2=Less than once per week; 1=Not at all	= 0 if Not at all; 1 otherwise.	Yes. This outcome was not pre-specified and was analyzed after writing the AP. It was an omission from our AP and helped us reconcile the negative (insignificant) effect on V7.3.
V7.4	How many days did you use the internet over the past week?	Number	=number of days of internet use in the past week	Minor. When available, we use information on internet usage in the past month to fill in missing values (17 observations).

RQ7. Does access to high quality online information impact internet use patterns? (Columns 1 and 2 in Panel D of Table 7.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
U7.5 (I_10, index only)	a. What was the price of the bundle in MK?; b. Which services are included in the bundle?	a. Value (MK); b. Internet, WhatsApp, Facebook, Other	= total of all bundle price values of WhatsApp, Facebook or other social media bundles ; 0 if no bundles purchased	No.
U7.6 (I_10, index only)	I want to ask you about the applications you used last Wednesday/Saturday. Only include those that you personally used for at least ten minutes. Please refer to the numbers in the digital wellbeing dashboard. a. Which apps did you use last Wednesday?; b. What type of app is this?; c. For how many minutes?	a. WhatsApp, Facebook, Instagram, Chat GPT, TikTok, Google, Chrome, Browser, Email app, Wikipedia, Twitter, Vidmate, YouTube, Other. ; b. Email, browser, Messaging, Social media, Videos, Podcasts, Music, Games, Entertainment, News.; c. Number	=minutes using social media Wed/Sat.	No.
U7.7 (I_10, index only)	How often have you used [facebook/ twitter/ tiktok/ whatsapp] in the past month?	1 = never; 2 = rarely; 3 = sometimes; 4 = most of the time; 5 = always	= score	Minor. Equals 1 if no account or if did not use the internet in the past month.
U7.8 (I_10, index only)	Do you have a [facebook/ twitter/ tiktok/ whatsapp] account?	Yes or no	= 1 if yes	No.
U7.9 (I_11, index only)	Which internet or social media sites do you use for information about health topics?	Google; Wikipedia; The Nation Malawi; Times Malawi; Zodiak; BBC; WhatsApp; Facebook; Twitter; TikTok; Chat GPT; Instagram; Telegram	=1 if social media	No.
U7.10 (I_11, index only)	Now, I am going to read a list of options. I want you to tell me what is the best place to find information about health.	Ranking 1-7: Books; Wikipedia; Google; Chat GPT; Social Media (SM); Health Facility; Friend or family member.	=reverse rank of SM (index only)	Yes. We used top three sources, as we realized after analyzing the data (and publishing the AP) that many higher rank positions were missing due to a data collection error.

RQ7. Does access to high quality online information impact internet use patterns? (Panel C and Column 3 in Panel D of Table 7.)

# (Index)	Survey Questions	Answers	Outcome	Deviation from AP
V7.11	Now, can you open google chrome or whatever browser you usually use. I want you to look at your browsing history, and tell me how many different Wikipedia pages did you look at in the past week.	Number of different pages	=number of pages	No.
V7.11b	Has browsing data to construct V7.11?	Yes or no	=1 if V7.11 is non-missing; 0 if missing.	Yes. This outcome was not pre-specified and was analyzed after writing the AP. We added V7.11b because we had several missing values for the variable V7.11.
V7.12	Have you ever used Wikipedia?	Yes or no	=1 if ever used Wikipedia	No.
U7.13 (I_12, index only)	Which internet or social media sites do you use for information about health topics?	Google; Wikipedia; The Nation Malawi; Times Malawi; Zodiak; BBC; WhatsApp; Facebook; Twitter; TikTok; Chat GPT; Instagram; Telegram	=1 if Wikipedia; 0 otherwise	No.
U7.14 (I_12, index only)	Now, I am going to read a list of options. I want you to tell me what is the best place to find information about health.	Ranking 1-7: Books; Wikipedia; Google; Chat GPT; Social Media; Health Facility; Friend or family member.	=reverse rank of Wikipedia (index only)	Yes. We used whether Wikipedia is in top three sources as we realized after analyzing the data (and publishing the AP) that many higher rank positions were missing due to a data collection error.

E Timeline of Financial Support, Ethics, Data Collection, and Analysis Plans

This appendix documents financial support, ethics approvals, data collection, and trial registration for the project *Information, Education and Social Networks*, with a focus on health-related outcomes relevant to this paper. The original study refers to the trial registered as *Information, Education and Social Networks* on the AEA registry, and includes data collected in 2017-18 (baseline, endline, and browsing data). The follow-up study builds on the same trial, and includes data collected in 2023-25. We have updated the AEA registry to document the follow-up study (see the document PAP_HealthKnowledge_SexualHealth.pdf in the *Analysis Plan* section at https://www.socialscienceregistry.org/trials/3824/history/299395).

I. Original Study: Financial Support

The original study received financial support from the Social Sciences and Humanities Research Council (SSHRC) in 2017. The grant application proposed studying the following three research questions:

1. "Does internet access increase educational attainment among secondary school students in Malawi, and if so, through which specific channels?"

2. "Does internet access increase general knowledge on topics such as politics and health, and are students able to distinguish between accurate and inaccurate information?"

3. "Does providing an information source to a student affect that student's social network position?"

Derksen et al. (2022) and Derksen and Souza (2025) addressed Questions 1 and 3, respectively. For this paper, we later decided to narrow our focus to sexual health knowledge, partially addressing Question 2.

The grant proposal also noted: "In future work, we will plan to investigate longer term outcomes for these students, especially to measure internet literacy and use after secondary school ends." Section IV describes the follow-up study funding.

II. Original Study: Ethics Approvals

Data collection was approved by the University of Toronto Research Ethics Board (Protocol Reference # 34707) and the Malawi National Committee on Research Ethics in the Social Sciences and Humanities (Protocol Number P08/17/204).

The surveys did not collect information about students' own sexual behaviors. For questions on HIV and pregnancy, the enumerators stated:

"We would like to ask you some questions about your beliefs. These questions are not a quiz – you should just answer what you believe is true. I will start with some questions about HIV and pregnancy."

Enumerators then reminded students that they could refuse to answer any question.

III. Original Study: Data Collection and Pre-Analysis Plan

Data collection occurred between October 2017 and July 2018. We registered the trial on the AEA registry on February 5, 2019. Data collection preceded the registration, but data analysis, including the health knowledge outcomes, began after trial registration.

We pre-specified two primary outcomes: final grades in English and Biology (see Derksen et al. (2022)). We also pre-specified the following secondary outcomes:

1. Other academic outcomes
2. Aspirations
3. Internet literacy
4. Student time use
5. General knowledge
6. Social network position

The specific health knowledge questions analyzed in this paper were not specified as primary outcomes, but were included in the endline surveys, and fall under the secondary outcome category 'general knowledge' (item 5). The short-run analyses should be viewed as exploratory, as they were conducted after original trial registration but before the later health-focused analysis plan was written. Importantly, the complete set of sexual-health knowledge questions from the survey are included in this paper as outcomes.

The short-run results informed the follow-up data collection. Despite finding no short-run effect on health knowledge, we hypothesized that Wikipedia access may shift internet usage and consequently knowledge, behaviors, and attitudes in the longer term.

IV. Follow-up Study: Financial Support

The follow-up study received financial support from the Social Sciences and Humanities Research Council (SSHRC) in 2023. The grant application proposed studying the following three research questions:

1. "What are the long-term impacts of restricted internet access for high school students on academic achievement, career and income?"

2. "How does restricted access to internet technologies impact adolescent fertility and risky sexual behaviour?"

3. "How does providing restricted internet access in adolescence affect later engagement with information technology? In particular, does it enable them to more easily identify misinformation online?"

This paper addresses Question 2. Questions 1 and 3 are being addressed in separate ongoing work.

V. Follow-up Study: Ethics Approvals

In addition to updating our ethics approvals from the Malawi National Committee on Research Ethics in the Social Sciences and Humanities, we obtained ethics approvals from the University of Toronto Research Ethics Board (Protocol Number: 43170), the Comités d'éthique de la recherche avec des êtres humains de l'Université Laval (Approval Number: 2022-315/30-09-2022) and the Carleton University Research Ethics Board (Protocol Number: 123121).

The follow-up survey included particularly sensitive questions about participants' own sexual behaviors and their attitudes on topics that are taboo in the Malawian context such as same-sex relationships. To address concerns about these sensitive modules, we implemented the following procedures:

A. Before requesting participants' consent, enumerators informed participants of the survey objectives, including these two statements:

> "You will be asked to answer some questions about your education, career, family, income, sexual behaviour, knowledge and internet use."
>
> "Even if you choose to participate, if you are uncomfortable answering any of the questions, you can skip them or refuse to answer them. Discussing sexual behaviour might make you feel embarrassed. You can stop answering the questionnaire at any time and no one will be upset by your decision."

B. Finally, at the beginning of the sensitive modules, enumerators stated to respondents:

> "I am going to ask you some questions about your sexual behaviour and health. Remember that your answers are confidential: your identity is protected and will never be shared. You are free to skip any question."

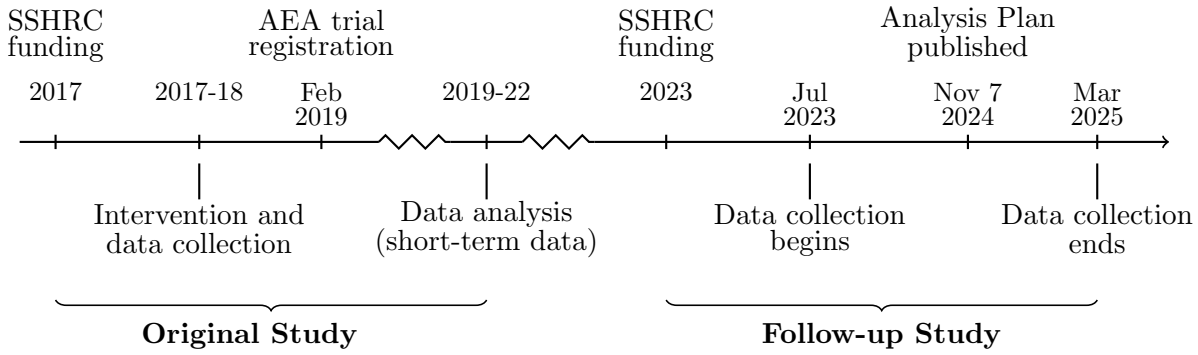
VI. Follow-up Study: Data Collection and Analysis Plan

The follow-up survey occurred between July 2023 and March 2025. We published the sexual health knowledge Analysis Plan (AP) on November 7, 2024, before completing data collection. Appendix D presents the complete AP and documents all deviations from the AP. Unlike the original study registration, the sexual health knowledge AP included detailed specifications. The AP was written after short-run health data had been collected and analyzed, meaning the long-run outcomes were pre-specified but informed by patterns observed in short-run data.

VII. Summary

In summary, this paper combines the two health-related research questions from the two SSHRC grants, with a narrowed focus on sexual health. Health knowledge outcomes using the endline surveys were broadly classified as secondary outcomes in the original study PAP and were analyzed before beginning the follow-up study. We wrote an analysis plan for this paper before completing the follow-up data collection (see PAP_HealthKnowledge_SexualHealth.pdf at https://www.socialscienceregistry.org/trials/3824/history/299395), and the paper follows that analysis plan (see Appendix *Analysis*). The figure below summarizes the chronology for this paper.

Appendix Figure E1: Project Timeline



Notes: Timeline of the project showing key dates for financial support by the Social Sciences and Humanities Research Council (SSHRC), data collection, trial registration, and analysis. The original study data collection was conducted from October 2017 to July 2018, with trial registration in February 2019 and analysis beginning after registration and continuing through 2022. The short-term health knowledge outcomes analyzed in this paper were registered as secondary outcomes under 'general knowledge' in the original registry. The follow-up study began in 2023, with data collection from July 2023 to March 2025. The analysis plan for this paper was published in November 2024 and specified analysis of all health-related outcomes (both short- and long-run outcomes).

F Examples of Examinations

Life Skills

Appendix Figure F1: Example 1: Life Skills Examination

20. Which of the following is a major problem of boy-girl relationships?
A. desire to be kissing each other
B. desire to have sexual intercourse
C. being laughed at by their friends
D. desire to be teaching each other school work

Appendix Figure F2: Example 2: Life Skills Examination

10 Which of the following is not a way of preventing sexually transmitted infections.

A Shying away from risky cultural activities
B Practicing abstinence until marriage
C Isolating infected people from one's group
D Avoiding risky sexual activity

11 Why is it advisable to spend time chatting with people living with HIV and AIDs in our homes and communities.

A It relieves them of fear, hopelessness and loneliness.
B It prevents them from committing suicide
C It helps them get material support
D It helps them get spiritual

Appendix Figure F3: Example 3: Life Skills Examination

11. Which of the following sources can give boys and girls correct and accurate information about sex and sexuality?
    A. Vendors
    B. Parents
    C. Peers
    D. Dating sites

Social Studies

Appendix Figure F4: Example 1: Social Studies Examination

2. Things that a society expects a male or a female to do by virtue of being either male or female.
A. Gender
B. Sex preference
C. Gender roles
D. Gender responsibilities

Appendix Figure F5: Example 2: Social Studies Examination

1.
a. Give any **three** reasons why women are always victims of gender-based violence in Malawian families.

_____

_____

_____

_____

_____

_____(6 marks)

Appendix Figure F6: Example 3: Social Studies Examination

21. Which of the following is the importance of counseling guardians of HIV/AIDS patients?
    A. To help them avoid contracting the virus.
    B. To help the patient recover from the disease.
    C. To prevent the patient from infecting other people.
    D. To help them keep the patient away from other people.

Appendix Figure F7: Example 4: Social Studies Examination

45. How can one avoid infection when caring for HIV and AIDS patients?
    1. Washing hands before attending to the patient.
    2. Wearing gloves when there are open wounds.
    3. Cleaning any wounds using salt water.
    4. Washing laundry at high temperature.

    A. 1 and 2
    B. 1 and 3
    C. 2 and 4
    D. 3 and 4